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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

ENGINEERING STANDARD

SITE ADAPTION HANDBOOK AND CONSTRUCTABILITY ANALYSIS

MAJOR ACTIVITY LEVEL AIRPORT TRAFFIC CONTROL TOWER

FOREWORD

1. PURPOSE. This Engineering Standard provides the criteria and calculations utilized in the design of the FAA Standard Major Activity Level Airport Traffic Control Towers. Additionally, it provides instructions for adapting the standard design to suit local requirements.

2. REFERENCES.

a. Order 6930.24 FAA Standard Designs for Level III and Level IV Airport Traffic Control Towers

b. Drawings

	Title
No. E-5964 (15 sheets)	8-Sided Control Cab.
No. E-5960 (48 sheets)	High Activity Level Airport Traffic Control Tower Shaft Without Microwave Level - 120 ft., 150 ft., and 180 ft. Shafts.
No. E-5961 (48 sheets)	High Activity Level Airport Traffic Control Tower, 120 ft. Shaft (with Microwave Level).
No. E-5962 (48 sheets)	High Activity Level Airport Traffic Control Tower, 150 ft. Shaft (with Microwave Level).
No. E-5963 (48 sheets)	High Activity Level Airport Traffic Control Tower, Shaft (with Microwave Level).

c. Specifications

	Title
FAA-C-2584 (See Note)	High Activity Airport Traffic Control Tower, Tower Structure
FAA-C-2585	Major Activity Airport Traffic Control Tower, Cab Structure

Note: The standard specification is for a tower structure without microwave level.

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INTRODUCTION

FAA-NATIONAL STANDARD MAJOR ACTIVITY LEVEL-AIRPORT TRAFFIC CONTROL TOWER

The design concept developed herein for major activity level airport traffic control towers will be applicable for airports with 100,000 annual instrument operations or greater, and where Airport Surveillance Radar (ASR) service is available. In addition, Precision Approach Radar (PAR) and Airport Surface Detection Equipment (ASDE) may be available. Airports with annual instrument operations between 75,000 and 99,999 may also be considered for a structure of this type. As such, the airport would serve a large city or populated area. Most of these ATCT's will be operating around-the-clock.

Towers will be 120', 150' or 180' high and will have the capability of receiving a variety of cab configurations and base building connections.

FAA-NATIONAL STANDARD MAJOR ACTIVITY LEVEL-AIRPORT TRAFFIC CONTROL TOWER

1. Design Criteria

The design has been prepared in accordance with FAA-ER-440-029, "Major Activity Level Airport Traffic Control Tower, Architect/ Engineer Design", dated 13 March 1970, and documents listed therein.

2. Reviews

a. Phase "A" Review, August 3, 1970 - August 31, 1970.

b. Phase "C-1" Review, January 4, 1971 - February 1, 1971.

c. Phase "C-2" Review, March 29, 1971 - April 19, 1971.

d. Phase "C-3" Review, June 2, 1971 - June 16, 1971.

e. Phase "C-4" Review, June 30, 1971 - August 20, 1971.

3. General

The objectives of the design concept are to provide the FAA a tower with:

1. The ability to adapt to modification of requirements and accommodate such changes over time to minimize obsolescence.

2. Attractive cost characteristics.

3. A structural system which could be easily fabricated in all sectors of the country and through all climatic seasons.

4. An architectural system which could subtlely adjust its visual characteristics to blend with architectural materials of each individual airport.

5. An architectural concept with a structural and functional clarity of design.

To minimize the possibility of obsolescence, Welton Becket and Associates has developed a structural support system comprised of four service cores which extend from the base building to the cab and allow the space required for microwave and special equipment to be accommodated as "plug-in" pieces of hardware which can be modified as required without disturbing the basic structural system. Constructed from concrete local to the region, or as specified by the airport architect, the service cores are proposed to be precast on or off-site in concrete units of 10' x 10' x 7-1/2' high. These units will wiegh approximately 20 tons and are sized to be easily trucked to the site under normal procedures. Once at the site, following completion of foundations, the units would be stacked on top of one another to form the four service cores. These service cores house the (1) elevator (2) exit stairs (3) communication cables and (4) power cables.

To allow the occasional modification and maintenance required to the communication and power cables, controlled access will be provided via the elevator at 45-foot intervals or at any 15-foot interval required by the individual adaption, and stairs at 15-foot intervals. At these levels, they will exit to open platforms structurally connecting the service cores. The service cores, with the exception of the stairs which is ventilated, are enclosed and provided with tempered air.

Near the top of the tower a sub-junction level is provided and on the alternate design four quadrants of microwave space are provided to house the dishes and equipment necessary for this function. These spaces are designed to give the microwave 360-degree visibility. This level is also the terminal floor of the elevator with access to the junction level and the cab provided by stairs. The junction level provides toilets, stairs to the cab. elevator overrun and equipment, and a ready room. Access to the window walkway around the cab is also gained from this level thru a hatch to the deck above.

Due to the design requirements to accommodate the eight-sided national standard cab, a modified C-2 cab and the eleven-sided cab, a common connector ring is provided between the cab and junction levels. Stairs are also positioned in such a location as to require no modification to the tower itself when different cab configurations are required, thus emphasizing the flexibility of this tower design.

4. Site Adaption

Flexibility was a major consideration in the design of the national standard major activity level airport traffic control tower. Each tower will require a supporting base building designed for the specific functional requirements of the airport and its climatic, wind loading and seismic conditions. The following should be considered:

a. Exterior Finishes - As stated above, the concrete modules may be changed in appearance by changing cement, aggregate, and surface finish. Color of metal components may vary but should be kept in the dark range to eliminate glare.

b. Interior Finishes - Finishes and colors are suggested for economy and durability. Flooring, ceiling, and window wall systems of the Tower Foyer should be considered with the design of the base building.

c. Base Building Connection - With minor modifications, a variety of base building configurations may be used with the tower. Access to the Tower Foyer is possible from any or all of the four sides. The standard design has been shown with access from one side only for use with an offset base building. The Dallas - Fort Worth project has access from two sides by connecting galleries to a building which completely surrounds a central court and tower.

d. Platform levels - Additional equipment and operational spaces are possible at any of the work platforms. All tower heights have been designed to accept an 80-foot diameter space.

e. Climatic Conditions - Wind and temperature should be considered at each site for insulation, glass, and facing panel design. Note wind loading limitations for large sizes of insulating glass. When the tower is built in severely cold climates, it may be desirable to add deicing systems at the microwave shielding panels and open work platforms. See the mechanical portion of the site adaption for design of the deicing systems. In both cases gas fired radiant heaters are suggested for economy. These systems are not proposed as part of the standard design. Deicing equipment for the microwave shielding should be required only in very rare instances due to the slope and slick surface of the panels.*

f. Seismic - Connection between the base building and tower, between glass and structure, between interior partitions and structure, and support of ceilings and light fixtures must be considered should the project fall in a seismic zone. Basic structure will be controlled by wind rather than seismic conditions.

g. Bird Control - Roosting birds at the open work platforms are not expected to be a problem at most locations. Should they prove to be a nuisance at a specific site, they may be eliminated by use of long lasting chemicals easily spread by a caulking gun. Bird-X, Inc., is one manufacturer of such products.

5. Construction Period

The critical path study for the first use of the major activity level airport traffic control tower at the Dallas - Fort Worth Regional Airport indicates that a tower with base building can be completed in one year.

6. Statement of Probable Cost

Estimated construction costs based on 1971 construction are as follows:

	w/Microwave	w/o Microwave
180' tower with eight sided cab	$877,764	$752,075
150' tower with eight sided cab	802,427	676,010
120' tower with eight sided cab	733,533	607,859

The above costs are for the Houston, Texas area. The Houston, Texas building cost index is approximately 93.4% of the U.S. average cost index based on "Engineering-News Record", March 1971.

*Alternate Microwave design encloses dishes.

AREA TABULATIONS - NATIONAL STANDARD HANDBOOK - 23 FEBRUARY 1971

TOWER ROOM OR FUNCTION	FLOOR SPACE SQ. FT. PROGRAM	FLOOR SPACE SQ. FT. DESIGN
Control Cab - 8 sided	400	515
Control Cab - 11 sided	400	532
Control Cab - 5 sided		412
Microwave Level		
Equipment Spaces (4)		(1135)
Battery Racks		(254)
Corridor		(100)
Junction Level		
Toilets		(40)
Ready Room		(70)
Elevator Equipment		(166)

STRUCTURAL

FAA-NATIONAL STANDARD MAJOR ACTIVITY LEVEL-AIRPORT TRAFFIC CONTROL TOWER

1. Design Criteria

The design has been prepared in accordance with FAA-ER-440-029, "Major Activity Level Airport Traffic Control Tower, Architect/ Engineer Design", dated 13 March 1970, and documents listed therein.

Design wind loads are in accordance with the requirements of Volume I, Uniform Building Code, 1967 edition. A separate analysis was made for the 120 foot, 150 foot and 180 foot tower. The 120 foot and 150 foot towers were designed for a 40 p.s.f. wind pressure area and the 180 foot tower was designed for a 30 p.s.f. wind pressure area.

Seismic design considerations where not investigated for this phase of the tower design. It was determined during the preliminary phase of the project that wind rather than seismic considerations would be the controlling factor in the tower design.

2. Reviews

a. Phase "A" Review, August 3, 1970 - August 31, 1970

b. Phase "C-1" Review, January 4, 1971 - February 1, 1970

c. Phase "C-2" Review, March 29, 1971 - April 19, 1971

d. Phase "C-3" Review, June 2, 1971 - June 16, 1971

e. Phase "C-4" Review, July 30, 1971 - August 20, 1971

3. General

The basic structural design concept was to develop as simple a support system as possible as a base for the air control facilities required by the F.A.A. Four individual towers or modules act as columns for the facilities. The vertical module was set at 15 feet with a 7 foot 6 inch sub module.

The individual units that make up the tower are precast concrete and weigh a minimum of 18 tons each and a maximum of 20 tons each. The design concrete strength for the precast units is 5000 psi and the reinforcing steel has an yield strength of 60,000 psi. The units will be stacked in place, aligned and then post-tensioned by means of a stressed bar system. Stressing will be done at 30 foot increments or at designated locations indicated on the contract drawings.

Structural steel work platform will be located at each 15 foot elevation increment. These platforms or cable access levels are designed so that they may be used to help align and brace the precast tower units prior to post-tensioning. These access levels will have a metal grating for a floor system.

The two 15 foot levels directly below the cab level will serve as the Junction Level and Sub-junction Level or an alternate design as the Microwave Level. These levels will be composed of a Structural steel beam system framing between and cantilevering from the precast towers. The floor system will be composed of a composite metal deck and concrete slab. The design concrete strength will be 3000 psi and the reinforcing steel will have a yield strength of 60,000 psi.

The towers were designed to support an additional enclosed area similar to the Weather Station on the Dallas-Ft. Worth project. If such a structure is desired on a particular project, the connections to the precast tower module must be designed at that time. Some of the cable access levels may also be enclosed.

The foundation for the four individual tower units was designed as a single concrete mat 4 feet in thickness. The foundation was designed for both gravity loads and overturning moments imposed by the wind loading. A soil bearing value of 4000 p.s.f. was used in the design. This basic foundation will need redesigning based on the actual soil characteristics for the different areas in which the towers will be located.

The tower was designed for height of 120 feet, 150 feet and 180 feet. Within certain limits and with careful analysis additional height might be added to the tower for a particular project. It is also possible to use the same basic structural system for towers of a lesser height than 120 feet.

Two basic cab structures were designed for placement atop the tower structures. The present 5 sided standard cab structure was investigated and a special connecting curb was provided for attachment of the cab to the tower. No further modifications to the cab were needed to make it compatible with the new tower design.

A new design was developed for a standard 8 sided cab structure. This cab design was based on a rigid frame structural grid system. The column and beams are standard structural shapes and the roof deck is an 1½ inch ribbed metal deck. Two different penthouse structures were provided for the cab. The lower profile structure is the standard design. The higher profile penthouse is for cabs that will have an A.S.D.E. Radar installation mounted atop the penthouse.

Design calculations showing the design criteria and the individual member design are included in this Site Adaption Handbook. Calculations were prepared in the conventional manner and with the aid of an in house IBM 1130, 8K One Disk Drive Computing System.

NOTE: REFER TO WORKING AND DATA SHEETS, PAGES 4S thru 121S.

MECHANICAL

FAA-NATIONAL STANDARD MAJOR ACTIVITY LEVEL AIRPORT TRAFFIC CONTROL TOWER

1. General

Cooling and heating for the tower is provided by circulating chilled water and hot water to conventional velocity air handling units of the single zone and fan-coil unit types. Low pressure steam is required for humidification in the cab.

2. Cooling Source

a. The normal source of chilled water is the Base Support Building chilled water system which supplies 46 degrees F. or colder supply water to the tower. Base Building chilled water pumps are used to provide water circulation to the cooling coils in the tower.

b. Extend the 2-1/2 inch CHS and 2-1/2 inch CHR lines to the Base Support Building chilled water system. Static pressure at the chilled water system must be at least the height of the tower converted to psi plus 15 psi.

3. Heating Source

a. The normal source of hot water is the Base Support Building hot water system which supplies 180 degrees F. or hotter supply water to the tower. Base Building hot water pumps are used to provide water circulation to the heating coils in the tower.

b. Extend the 2 inch HWS and 2 inch HWR lines to the Base Support Building hot water system. Static pressure at the hot water system must be at least the height of the tower converted to psi plus 15 psi.

4. Low Pressure Steam

Low pressure steam for humidification is normally supplied from the Base Building humidification steam system.. An alternate system would be to install pan-type electrically fired humidifiers in the cab return air, should humidification not be provided to the Base Support Building. Extend the 1-1/4 inch low pressure steam line to the Base Support Building steam system.

5. Compressed Air

Compressed air shall be supplied from the Base Support Building compressed air system. Extend this 1 inch compressed air line to the Base Support Building compressed air system.

6. Instrument Air

Instrument air shall be supplied from the Base Support Building instrument air system. Extend this 1 inch instrument air line to the Base Support Building instrument air system.

7. Pre-treated Outside Air

Pre-treated outside air will be supplied from the Base Building at a supply temperature of 55° FDB maximum to 40° FDB minimum.

8. Base Level - Elevator Lobby Air Conditioning

Provide a separate air conditioning zone from the Base Support Building to provide cooling air to this base level lobby. Allow this air to return to the Base Support Building return air system. This system may be changed if different architectural lobby treatment is provided.

9. Base Level - Electrical Cable Chases Air Conditioning

Provide a separate air conditioning zone from the Base Support Building to provide cooling air to these base level chases. This air is wasted at the top of each chase.

10. Air Handling Unit Schedule

a. Site Variations: The mechanical and electrical plans are also so arranged as to permit selection of the appropriate cooling and heating zones within which any specific site will be located. Such zones are as scheduled on the drawings. Select the applicable cooling and heating zone based upon the ASHRAE conditions for the site that corresponds with the listed site.

b. Under the Fan data and the cooling coil data, cross out all but the one applicable zone and related data.

c. Under the heating coil data, cross out all but the one applicable zone and related data.

d. AHU-1 and AHU-2 are applicable only to the octagonal cab design; cross out AHU-3 if octagonal cab is used.

e. AHU-3 is applicable only to the C-2 cab design; cross out AHU-1 and AHU-2 if C-2 cab is used.

11. Junction Level Plans 5 & 5A

Two different junction level plans are provided. Pull out and discard the drawing No. 5A if the octagonal cab is to be used. Pull out and discard the drawing No. 5 if the C-2 cab is used.

12. Tower Section Drawings 6, 6A, 7, & 7A

Four tower section drawings are provided. Pull out and discard drawings 6A & 7A if the 8 sided cab is to be used. Pull out and discard drawings 6 & 7 if the C-2 cab is to be used.

13. Instrument & Controls 9, 9A, 10, & 10A

Four different control drawings for the cab A/C controls are provided. Pull out and discard drawings 9A and 10A if the octagonal cab is to be used. Pull out and discard drawings 9 and 10 if the C-2 cab is to be used.

14. Specifications

a. There are two sets of specifications, one for the cab and one for the tower. The tower specification includes all items in the cab, so if a tower is to be constructed along with a cab, then the cab specification need not be included. The cab specification is to be used only if an octagonal cab is to be constructed to top of an existing tower.

b. The tower specification may be used as a guide specification for the entire project by expanding it to include items in the Base Support Building. A copy of the Dallas - Ft. Worth Regional Airport Specifications may be more applicable as a basic "Guide Specification" since this includes all items required for a control tower plus most items required for a Base Support Building.

15. Calculations

a. HVAC Load for C-2 cab is assumed to be identical to the 8 sided cab load since the area and configuration of glass, panels, roof, and etc. closely approximate the 8 sided cab. Insulation is not defined as to locations, thickness, etc. on the standard C-2 cab drawings, so be sure to add 3" Batt fiberglass insulation to the underside of the roof deck and 2" insulation behind wall panels.

16. Design Conditions

Refer to Drawing M-1.

ALSO: WORKING AND DATA SHEETS, PAGES 4M thru 73M.

ELECTRICAL

FAA-NATIONAL STANDARD MAJOR ACTIVITY LEVEL AIRPORT TRAFFIC CONTROL TOWER

1. Service

The electrical service to the tower will be two sets of 277/480 volt, three phase, four wire feeders, one to each tower main distribution panel.

2. Distribution

a. All power to the tower will be supplied from the Base Support Building essential buses "A" and "B". (two separate sources). A separate feeder from essential bus "A" and a separate feeder from essential bus "B" are provided to essential power distribution panels for Microwave* and Cab equipment. These distribution panels are divided into two separate electrical sections. Each section has a main circuit breaker. The two main breakers are bused together through a normally open tie breaker. Each feeder is capable of supplying all of the distribution panel load. In the event of a power outage on one feeder, the other feeder may be manually transferred so as to provide power for all of the electrical load connected to the distribution panel.

b. Cab power is provided by two separate feeders from a distribution panel. One feeder is connected to the essential bus "A" section power and the other feeder is connected to the essential bus "B" section power. The feeders are routed through an automatic transfer switch and to the load. In the event of a power failure, the transfer switch will automatically transfer the load to the other feeder.

c. Essential mechanical equipment motors are provided power from tower distribution panel. Motor starters shall be individually mounted at the Microwave* or Junction Level equipment rooms.

3. Dry Type Transformers

Dry type transformers are used to transform the 480 volt service to 120/208 volts, 3 phase, 4 wire, "Wye" systems.

4. Power Utilization

Power is utilized as follows:

*Note: Alternate for tower without microwave level in which a sub-junction level is provided.

480 volts, 3 phase for motors 1/2 HP and larger.
120 volts, 1 phase for motors 1/3 HP and smaller.
277 volts, 1 phase for fluorescent and mercury lighting.
120 volts, 1 phase for incandescent lighting.
120 volts, 1 phase for duplex convenience outlets.
120/208 volts, 3 phase, 4 wire for all FAA equipment.

5. Grounding Systems

The following separate grounding systems are provided. These systems shall be extended to the base of the tower and connect to the Base Support Building systems.

Building electrical system.
Radio equipment system.
Radar equipment system.
Lightning protection system.

6. Telephone Conduit System

A tray system will be provided from the tower base to the cab sub-floor.

7. Lightning Protection System

A lightning protection system is provided with a grounding loop around tower base. The tower lightning protection system shall be coordinated with the Base Support Building lightning protection system.

8. Door Monitoring System

A door monitoring system for the cab door is provided.

9. D.C. Power Supply

A D.C. power supply system for the radio equipment is provided. The system consists of wet cell batteries and battery charger. System located at Microwave* Level.

10. Fire Alarm System

a. A fire alarm system consisting of products of combustion (ionization) automatic detectors is provided. The detectors will be connected to the Base Support Building fire alarm system.

b. The duct detectors are wired to shut "Off" its associated air handling unit fan.

*Note: Same as 1E.

c. The tower and cab fire alarm system and equipment will be coordinated with and compatible with the Base Support Building fire alarm system.

11. Communication System

A communication system for two-way conversations between individuals and areas is provided. The system will be connected to the Base Support Building. The tower and cab intercommunication system and equipment will be coordinated with the Base Support Building intercommunication system. The tower and cab intercom equipment shall be compatible with the Base Support Building central switching station or master intercom system.

12. Lighting

General lighting is provided by fluorescent lighting fixtures. Incandescent lighting fixtures are used when a dimmer is required. Mercury lighting fixtures are used for exterior lighting.

13. Specifications

a. There are two sets of specifications, one for the cab and one for the tower. The tower specification includes all items in the cab, so if a tower is to be constructed along with a cab, then the cab specification need not be included. The cab specification is to be used only if an octagonal cab is to be constructed on top of an existing tower.

b. The tower specification may be used as a guide specification for the entire project by expanding it to include items in the Base Support Building. A copy of the Dallas - Ft. Worth Regional Airport Specifications may be more applicable as a basic "Guide Specification" since this includes all items required for a Base Support Building plus a control tower.

14. Drawings

a. If the C-2 cab is to be used with the tower, pull out and discard drawings E-4 and E-7. On sheet E-5 "Notes", delete items and notes 2 and 3 for C-2 cab installation.

b. If the 8-sided cab is to be used with the tower, pull out and discard drawings E-4A and E-7A.

NOTE: REFER TO WORKING AND DATA SHEETS, PAGES 4E, 4Erev.,5E,&6E.

PLUMBING

FAA-NATIONAL STANDARD MAJOR ACTIVITY LEVEL AIRPORT TRAFFIC CONTROL TOWER

1. Water Supply

Cold water supply for the cab is pressurized by a pump and hydro-pneumatic system. The pump with associated surge tank, etc., or other accessories is a part of the Base Support Building support equipment. An elevated hydro-pneumatic tank with controls and accessories is in the junction level of the tower. The pump should be selected to deliver 12 gpm against a head equal to the height of the tower converted to psi plus 30 psi.

Electric water heater is provided at the Junction level.

2. Storm Drainage

Extend the 4 inch storm drain downspout to the Base Support storm drainage system.

3. Sanitary Sewer

Extend the 4 inch sanitary sewer line to the Base Support sanitary drainage system.

4. Specifications

a. There are two sets of specifications, one for the cab and one for the tower. The tower specification includes all items in the cab, so if a tower is to be constructed along with a cab, then the cab specification need not be included. The cab specification is to be used only if an octagonal cab is to be constructed to top of an existing tower.

b. The tower specification may be used as a guide specification for the entire project by expanding it to include items in the Base Support Building. A copy of the Dallas - Ft. Worth Regional Airport Specifications may be more applicable as a basic "Guide Specification" since this includes all items required for a control tower plus most items required for a Base Support Building.

NOTE: REFER TO WORKING AND DATA SHEETS , PAGES 2P thru 4P.

APPENDIX I

Changes to FAA Specification FAA-C-2584 for Tower Structure with Microwave Level

Attached pages shall replace pages of like number in tower specification when an ATCT with microwave level is to be constructed:

Replace Page	With Page
i	i
9	9
39	39
62	62
68	68
80 thru 84	80 thru 84
85	85 and 85A
86	86 and 86A
88 and 89	88 and 89
93	93 and 93A
96	96 and 96A
98	98 and 98A
118	118 and 118A
125	125 and 125A

THESE PAGE CHANGES ARE AVAILABLE SEPARATELY BY ORDERING : SPECIFICATION FAA-C-2584, SUPPLEMENT-1 .

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If core tests fall 10% below specified strength, the work in question shall be removed and replaced by the contractor at no additional expense to the Government.

1-2.4.2.3.12 Testing steel.- If reinforcing steel is purchased direct from a United States mill, manufacturer's approved test sheets will suffice. If steel is from dealer's stock, perform tension and bending tests on three separate samples for each size of bar in every 5 tons of each type of steel as specified in the appropriate ASTM specification. Contractor shall furnish all material for testing and pay for all such tests. Steel supplier shall furnish mill certificate reports.

1-2.4.2.4 Structural steel work

1-2.4.2.4.1 - Secure samples of structural steel (that is not identified by mill shipping statements and certified mill reports of heat and melt numbers) in ample quantities to perform structural tests on 5% of all such unidentified steel. Contractor shall furnish all such material for testing and pay for all such tests.

1-2.4.2.4.2 - All full penetration butt welds shall be inspected by radiographic testing. Twenty-five percent of all other welds shall be inspected by ultrasonic testing as directed by Contracting Officer.

1-2.4.2.5 Roofing

1-2.4.2.5.1 - Secure samples of roofing materials proposed for use in ample quantities to perform all testing required.

1-2.4.2.5.2 - A maximum of 4 sections will be cut on the roofed surfaces. Cuts shall be made before final floodcoat and gravel is placed. If tests indicate roofing complies with the specifications, roofing shall be patched by contractor and at his own expense. If tests indicate roofing does not comply with the specifications, roofing shall be removed and replaced with acceptable roofing or additional felts and wrappings added by contractor at no additional expense to Government.

1-2.4.2.5.3 - The following tests are required:

1. Inspect roof cuts for compliance with the specifications.
2. Weigh roof cuts to verify compliance with the specifications.

* * * * *

3-6.4.2 Coverings.- Protect exposed flatwork such as treads, sills, formed thresholds, curbs, splashes, machine bases, ledges and similar construction will full board or plywood coverings as necessary to protect from damage by impact and from building rubbish. Control the use of water within the building so that no damage to previously installed work is permitted to occur.

3-6.4.3 Cold weather and hot weather operations.- Comply with requirements of Division 3, Section 3.

3-6.4.4 Flat surface finishes.- Finish monolithic concrete slabs and topping slabs as follows:

3-6.4.4.1 - Thoroughly compact concrete and strike surface at indicated levels by means of screeds set to proper elevations.

3-6.4.4.2 - Float surface with an approved disc-type power floating machine. Compact concrete to a smooth surface and continue floating operations until mortar fills all surface voids.

3-6.4.4.3 - After floating is complete and when concrete has hardened sufficiently, machine trowel concrete with a steel trowel to a smooth surface free from pinholes and other imperfections.

3-6.4.4.4 - When surface begins to produce ringing sound under machine, hand trowel with a steel trowel to a hard, dense surface free from imperfections.

3-6.4.4.5 - Finish slabs to ACI 301 Class A tolerance, plus or minum 1/8 inch variation from finished floor level in 10 feet.

3-6.4.5 Finish.- Finish slabs to receive topping slabs and/or mortar set materials to ACI 301 Class B tolerance (with a maximum variation of 1/4 inch in 10 feet) as specified in Paragraph 3-6.4.4.1 above. Consolidate and level concrete and roughen with stiff brush for scratched finish.

3-6.4.6 Waterproofing.- Finish slabs to receive membrane waterproofing following Paragraphs 3-6.4.4.1 through 3 above and to ACI 301 Class B tolerance of 1/4 inch in 10 feet. Finish with wood float and light steel troweling.

3-6.4.7 Wood float finish.- Use a slight rotary or darbied circular motion. # Use wood float finish underlying insulation and/or built-up roofing, waterproofing and elsewhere, as noted on the drawings. #

3-6.4.8 Formed surface finishes.- Finish as follows:

3-6.4.8.1 - Withdraw removable form ties and/or break off snap-ties less than one inch back of concrete surface. Dampen hole or depression with clean water and completely fill with neat cement grout. Make holes completely water tight.

3-6.4.8.2 - Remove fins and cut out honeycombed, imperfect and damaged areas. Apply bonding agent to assure proper adhesion and patch with approved grout.

6-1.3.3 Grades and uses.- Lumber shall be graded and used as follows:

6-1.3.3.1 - In general, all lumber shall be graded and grade-marked as herein specified and shall comply with the latest grading rules of the association under whose rules the material was produced.

6-1.3.3.2 - In the event contractor wishes to use lumber of other species or grades, he shall submit pertinent data for Contracting Officer's approval prior to placing orders.

6-1.3.3.3 - For interior framing, interior blocking, furring and miscellaneous rough lumber not otherwise specified: Standard Grade Douglas Fir, or No. 2 Southern Pine.

6-1.3.3.4 - For roof curbs and cants; and all nailers, blocking and plates in # contact with concrete and/or masonry: Standard Grade Douglas Fir, or No. 2 Southern Pine.

6-1.3.3.5 - Material shall be preservative treated as hereinafter specified. Treatment shall be applied after members are shaped.

6-1.4 Installation

6-1.4.1 Items.- Items shall include but not necessarily be limited to the following list which shall be a guide to the type of work of this section of the specifications:

6-1.4.2 Nailing blocks and ducks

6-1.4.2.1 - Formed to shapes and dimensions indicated.

6-1.4.2.2 - Secured in precise positions necessary to receive, support and engage subsequent work.

6-1.4.3 Wood grounds and backing

6-1.4.3.1 - Provide as necessary to engage and receive all trim, millwork, wood and metal finish, and including wall mounted fixtures and equipment as indicated.

6-1.4.3.2 - Secure in precise positions as necessary to receive, support and engage subsequent work. Install plumb, level, and true to line or grade. Except as otherwise indicated or approved, grounds and backing shall be anchored with 5/16 inch diameter bolts or equivalent strength screws in Rawlplugs. Except as otherwise indicated, space bolts and screws not over 16 inches o.c.

6-1.4.4 Preservative treated lumber.- General treatment is as follows:

6-1.4.4.1 - Lumber shall be treated in accordance with the requirements of the referenced "Standard Specifications" of the American Wood Preserver's Association which are hereby made a part of this section.

6-2.4.9 Joint types.- Work material in best manner, using dado, rabbet, lap, shoulder lap, and other joints as indicated, glued to provide greatest strength and using a minimum of nails and screws. If used, nails and screws shall be concealed. Use glue clamps. Make all mitered corners using cutter head on shaper that will provide an interlocking joint.

6-2.4.10 Exposed edges.- Round all exposed edges and corners of millwork to 1/16 inch radius. Provide edging on all exposed wood particle board or plywood edges. Edging shall run continuous and be solid material matching face veneer except fir plywood shall be edge banded with FAS clear gum. Miter edging at corners, glue solidly.

6-2.4.11 Sandpaper finish.- Provide all milwork with fine sandpaper finish ready for finishing and/or painting. No sanding across grain permitted. Install laminated plastic tops and edges with waterproof mastic as recommended or specified by manufacturer of laminated plastic used.

6-2.4.12 Kerfing.- On all trim exceeding two inches on one dimension, kerf of back-out side of piece as required.

6-2.4.13 Millwork items.- Painted base cabinets shall be as follows, unless otherwise noted on drawings:

6-2.4.13.1 Framing.- Southern Pine or Douglas Fir, except sight exposed framing shall be unselect birch.

6-2.4.13.2 Plywood

1. Closed within doors:

   a. Exposed two sides, INT-DEPA-A-A.
   b. Exposed one side, G1S-Sol S Unselect Birch.

2. Doors: G2S Unselect Birch.

3. Sub-tops covered with plastic surfacing: INT-DEPA-B-D

4. Edge strip on plywood: Unselect Birch or Gum

6-2.4.13.3 Plastic top.- Refer to "Materials" paragraph "Sheet Laminated Plastic Surfacing" above.

6-2.4.14 - Coordinate fabrication of millwork items to allow ample time for fulfilling "Wood Acclimatization" requirements as specified above.

6-2.4.15 - Coordinate cut-outs for hardware, sinks, etc., with applicable sections.

7-3 BUILT-UP ROOFING

7-3.1 General.- Hot asphalt and felt shall be used in all locations where specified by the architectural drawings. The roofing to be used and the installation process shall be as specified herein.

7-3.1.1 Preliminary considerations

7-3.1.1.1 - The provisions and requirements of the General Provisions and related documents are hereby made a part of this Section of the specifications.

7-3.1.1.2 - Refer to Division 1 for additional provisions and requirements which may affect the work of this section.

7-3.2 Applicable documents

7-3.2.1 Reserved

7-3.2.2 Source of ASTM documents.- American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

7-3.3 Materials

7-3.3.1 - Materials are roof deck types for board roof insulation.

7-3.3.2 Asphalt.- Comply with ASTM D 312, Type I and/or Type III. Locations as specified hereinafter.

7-3.3.3 Asphalt-saturated roofing felts - Comply with ASTM D 226, 15 lb type.

7-3.3.4 Double-coated base sheet.- Manufacturer's standard 43 lb. base sheet.

7-3.3.5 Double-coated roofing felts.- Comparable to Philip Carey No. 30 double-coated felt.

7-3.3.6 Roofing aggregates.- Crushed stone, gravel, or crushed slag, complying with ASTM D 1863, graded 1/4" to 5/8" with no more than 5% passing a No. 8 sieve. Moisture content shall not exceed 0.5% for crushed stone or gravel and 5.0% for crushed slag.

7-3.3.6.1 - Aggregate shall be washed clean and shall be free of all dust, dirt and other foreign matter.

7-3.3.6.2 - Shall be dry within specified limits when applied.

7-3.3.6.3 - Prior to start of work of this section, submit samples of proposed aggregate for Contracting Officer's approval.

7-3.3.7 Cant strips.- 4" x 4", unless detailed otherwise, formed from organic fiberboard complying with ASTM C 208, Class C.

7-3.3.8 Composition built-up flashing.- Comparable to Philip Carey Type 11 C/F.

7-3.4 Installation

7-3.4.1 Preparation of surfaces

7-3.4.1.1 - Surfaces to receive bituminous materials shall be dry and swept clean of all debris, dirt and dust. Metal flashings shall be available and ready for installation of roofing. All penetrations (piping, conduits, etc.) shall be in place, inspected and approved, prior to start of roofer's work.

7-3.4.1.2 - Surfaces shall be reasonably smooth and free from holes or projections which might cause puncture of the membrane. Cracks, holes and voids in sub-strate surfaces shall be carefully filled with approved fillers as necessary to provide a flush, solid surface to receive the roofing.

7-3.4.1.3 - Check installation of roof drains to verify installation at proper elevation with respect to adjacent construction. In the event drains should be installed too high for proper drainage, do not proceed with the work until the defective installation has been corrected.

7-3-4.2 Proportioning materials.- As a minimum, the following listed amounts and types of materials shall be evenly applied over each 100 square feet of surface covered. Alternate layers of felt and asphalt moppings.

7-3.4.3 Built-up roofing

1. Solid mopping of hot asphalt (Type III)	30 lbs.
2. One ply double coated base sheet	43 lbs.
3. One mopping of hot asphalt (Type I)	23 lbs.
4. Three plies of roofing felts	45 lbs.
5. Two moppings of hot asphalt (Type I)	46 lbs.
6. Flood coating of hot asphalt (Type I)	70 lbs.
7-3.4.4 - Approximate total weight of materials	257 lbs.
7-3.4.5 - Gravel or crushed stone	400 lbs.
7-3.4.6 - Slag	300 lbs.

7-3.4.7 Built-up roofing.- (contractor's option in lieu of paragraph 7-4.3.2 above.)

1. Solid mopping of hot asphalt (Type III)	30 lbs.
2. One ply double coated base sheet	43 lbs.
3. One mopping of hot asphalt (Type III)	23 lbs.
4. Two plies of double coated roofing felts	60 lbs.

5. Two moppings of hot asphalt (Type III) 46 lbs.

6. Flood coating of hot asphalt (Type I) 70 lbs.

7-3.4.8 - Approximate total weight of materials 272 lbs.

7-3.4.9 - Gravel or crushed stone 400 lbs.

7-3.4.10 - Slag 300 lbs.

7-3.4.11 Roof deck.- Deck shall be dry, smooth, and clean. No roofing shall be applied to insulation unless insulation is completely dry. If roof deck and/or insulation receives rain during this period or at any time prior to application of insulation and/or roofing, allow to completely dry before applying roofing.

7-3.4.12 Bitumen.- Bitumen shall be heated no higher than maximum temperature specified by manufacturer, in kettles which have working thermometers attached.

7-3.4.13 Method.- Install roofing and flashings in strict accordance with roofing manufacturer's specifications. Bitumen flood coat shall consist of not less than 70 pounds per 100 square feet, and shall be poured on and not mopped. Apply aggregate while bitumen is still hot. All aggregate shall be raked out smooth and even, leaving no visible terrace effect and no exposed asphalt.

7-3.4.14 Composition.- Composition base flashings and flashings shall be of comparable composition to Philip Carey's Type II C/F and Detail Numbers 5, 6, 7 and 10 as applicable. Roof edge detail shall be comparable to Philip Carey Detail No. 1.

7-3.4.15 Manufacturers

1. Philip Carey, Cincinnati, Ohio 45215.

2. John-Manville, New York, New York 10016.

3. Ruberoid, New York, New York 10017.

7-3.4.16 - Products of other manufacturers in order to be considered for use on this project shall comply with the requirements of this section.

7-3.4.17 - Applicator for work of this section shall be approved by the Contracting Officer and the manufacturer of the built-up roofing to be installed on this project.

7-3.5 Quality assurance

7-3.5.1 Samples.- Refer to Division 1 for submittal requirements and procedures. Contractor shall make four, 4 inch x 36 inch roofing test cuts as directed and located by the Contracting Officer. Test cuts shall be made after all felts are installed and prior to flood coat installation. Contractor shall then submit test cuts to Testing Laboratory for inspection and testing prior to flood coat and aggregate application.

7-3.5.2 Test cuts.- Contractor shall patch test cuts as follows:

7-3.5.2.1 - Scribe cut same number of felts that are in the roof and install in strict accordance with above roofing specifications, using same quality and quantity of materials.

7-3.5.2.2 - Directly on top of cut, place four additional layers of asphalt and felt in accordance with roofing specifications hereinafter. Each layer of felt shall overlap preceding layer by 4 inches at all edges.

7-3.5.2.3 - After test cuts have been tested and approved, proceed with application of flood coat and aggregate as specified hereinafter.

7-3.5.2.4 Manufacturer's literature.- Three weeks prior to the start of roofing work, submit triplicate copies of roofing manufacturer's printed specifications and installation instructions for Contracting Officer's review.

7-3.5.3 Warranty

7-3.5.3.1 - Submit written warranty, in approved form for a period of two years from date of acceptance.

7-3.5.3.2 - Warranty shall include roofing and base flashing and shall include the cost of labor and materials for the prompt correction of all failures occurring within the warranty period.

7-3.5.4 Reference specifications.- Roofing and base flashing shall be installed in strict accordance with roofing manufacturer's current published specifications for application over roof deck materials specified hereinafter.

7-3.5.5 Clean-up.- From time to time, during the work of this section, clean up and remove from the project site all containers and rubbish resulting from the work of this section and maintain the premises in a clean, orderly condition at all times. Upon completion remove all rubbish, tools, equipment, and un-used materials from the project site.

7-3.5.6 Exposed surfaces.- Take care and precautions to insure that bituminous materials do not come in contact with exposed surfaces. Contractor shall be responsible for the repair and/or replacement of all such disfigured materials. Such costs and expenses shall be borne by the contractor at no additional expense to the Government.

7-3.5.7 Preliminary meeting.- Prior to the start of work of this section, a preliminary meeting shall be held at the job attended by the contractor's superintendent, a representative of the roofing manufacturer, the roofing sub-contractor and his superintendent, and the Contracting Officer to review materials and application procedures.

7-3.5.8 Approved applicator.- Work of this section shall be performed by an applicator approved by the roofing materials manufacturer and subject to manufacturer's inspection. Applicator shall notify the manufacturer before commencing the roofing work, allowing not less than 72 hours to arrange for inspection by an employee of the manufacturer.

7-3.5.9 Manufacturer representative.- Roofing manufacturer's representative shall be present at the commencement of roofing work, but shall not be required to inspect subsequent incremental applications.

7-3.5.10 Modifications.- If contractor or roofing manufacturer require modifications to these specifications in order to comply with roofing details and roof warranty requirements, such modifications shall be submitted to Contracting Officer for review prior to performing the work. Under no circumstances shall base layer be lesser in quality than 43 pound asphalt coated felt.

7-3.5.11 Coordination.- Metal flashings that are an integral part of the roofing shall be installed simultaneously with the roofing application. Consult the drawings and specifications of other sections, and with the applicators for work of other trades, in order to coordinate their work with the work under this section and to avoid omissions and delays. Responsibility for coordinating the work of this section with that of other trades shall be an obligation under this section. Determine that the roofing installation, including the metal accessories, is suitable to receive the required warranty.

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7-4 SHEET METAL WORK

7-4.1 General.- This section covers sheet metal work. The material to be used and the application process shall be as specified herein.

7-4.1.1 Preliminary considerations

7-4.1.1.1 - The provisions and requirements of the General Provisions and related documents are hereby made a part of this section of the specifications.

7-4.1.1.2 - Refer to Division 1 for additional provisions and requirements which may affect the work of this section.

7-4.2 Applicable documents

7-4.2.1 - All work of this section shall be in accordance with the applicable provisions of the following listed reference specifications and manuals:

7-4.2.1.1 - "Architectural Sheet Metal Manual," AIA File No. 12-L as published by the National Association of Sheet Metal and Air Conditioning Contractors.

7-4.2.1.2 - Plastic Roofer's Cement, Federal Specification SS-C-153, Type 1.

7-4.2.1.3 - Reserved

7-4.3 Materials

7-4.3.1 Steel.- Mild or soft temper stainless steel (noted as metal flashing on drawings).

7-4.3.1.1 - Comply with requirements of ASTM A 167, Type 304, soft temper.

7-4.3.1.2 - For thicknesses, refer to drawings and item specifications: minimum .0187 inch thickness (26 USS gauge).

7-4.3.1.3 - Finish No. 2D (as rolled mill finish).

7-4.3.1.4 - Manufacturer and type is Washington Steel Corporation, "Microflex" or Republic Steel, "Duroflash."

7-4.3.1.5 Galvanized sheet steel (galvanized iron)

7-4.3.1.5.1 - Armco "Zincgrip-Paintgrip" sheet steel.

7-4.3.1.5.2 - For gauges, refer to drawings and item specifications; minimum 26 USS gaugs.

7-4.3.2 Solder.- All solder shall be 50% block tin and 50% pig lead. Contractor shall use the flux best suited for material being soldered. All joints shall be wiped clean of flux after soldering. Acid fluxes shall be completely neutralized by washing the soldered joint with soda.

7-4.3.3 Plastic roofer's cement.- Comply with the requirements of Federal Specification SS-C-153, Type 1.

7-4.3.4 Rosin sized building paper.- Smooth, unsaturated, weighing 6 pounds per 100 square feet.

7-4.3.5 Fasteners

7-4.3.5.1 - Galvanized, cadmium plated or stainless steel..

7-4.3.5.2 - Provide rivets, nails, sheet metal screws, machine screws, and self-tapping screws of sizes and types best suited for conditions of use.

7-4.3.6 Sheet Lead

7-4.3.6.1 - Comply with requirements of Federal Specification QQ-L-201, Grade B.

7-4.3.6.2 - For weight per square foot, refer to drawings and item specifications, minimum 4 pounds per square foot.

7-4.4 Installation

7-4.4.1 Workmanship

7-4.4.1.1 - Accurately shape and install sheet metal as indicated on drawings.

7-4.4.1.2 - Members shall finish with true, straight and sharp lines. Intersections shall be coped to an accurate fit and securely soldered.

7-4.4.1.3 - Exposed edges of sheet metal work shall be turned back ½" (hemmed); exceptions as approved by Contracting Officer.

7-4.4.1.4 Form. - Fabricate and install sheet metal work as necessary to provide for expansion and contraction and maintain watertightness throughout the work. Perform all work in accordance with applicable requirements of reference specifications.

7-4.4.1.5 Joints. - Except as otherwise indicated, joints shall be full lapped. Make waterproof corner joints by soldering solid.

7-4.4.2 Soldering

7-4.4.2.1 - Material shall be cleaned and tinned prior to soldering.

7-4.4.2.2 - Use heavy coppers of blunt design, properly tinned.

7-4.4.2.3 - Shall be done slowly with well heated coppers to thoroughly heat the sheet and completely sweat the solder through the full width of seam. Seams shall show at least 1" of evenly flowed solder.

7-4.4.2.4 - Excess flux shall be removed and surfaces neutralized immediately after soldering.

7-4.4.3 Isolation of dissimilar materials

7-4.4.3.1 - Sheet metal items in contact with dissimilar metals, masonry, mortar and concrete shall be given a heavy coat of Pratt and Lambert or other acceptable asphaltic varnish on the contact surface prior to installation.

7-4.4.3.2 - Do not coat sight exposed surfaces or surfaces to be sealed with sealant materials.

7-4.4.4 ITEMS

7-4.4.4.1 General - Sheetmetal features and related work are not necessarily individually described. Provide all sheetmetal work as necessary for a complete, watertight installation. Following is a list which shall be a guide to the type of work of this section of the specifications.

7-4.4.4.2 Pitch pockets

7-4.4.4.2.1 - Provide at roof as indicated.

7-4.4.4.2.2 - Fabricate from mild stainless steel.

7-4.4.5 Flashing and counterflashing

7-4.4.5.1 - Refer to drawings and details for design.

7-4.4.5.2 - Fabricate from mild stainless steel.

7-4.4.5.3 - Lap joints 6 inches, bed in plastic cement and secure with No. 8 SMS at 3 points each joint.

7-4.4.6 Gravel guards and fascias

7-4.4.6.1 - Refer to drawings and details for design.

7-4.4.6.2 - Fabricate from mild stainless steel.

7-4.4.6.3 - Secure gravel guards, bedded in plastic cement, to blocking with wood screws or stronghold-type nails spaced 4 inches o.c.

7-4.4.6.4 - Coordinate installation of gravel guards with roofing work.

7-4.4.6.5 - At joints, bed gravel guard in plastic cement and secure one side to backing strip by soldering solid. Do not use screws or nails in exposed vertical face of gravel guard.

7-4.4.7 Scuppers

7-4.4.7.1 - Refer to drawings and details for design.

7-4.4.7.2 - Fabricate from mild stainless steel.

7-4.4.7.3 - Coordinate installation of scuppers with roofing work and gravel guards.

7-4.5 Quality assurance

7-4.5.1 Shop drawings

7-4.5.1.1 - Required for all items of this section

7-4.5.1.2 - Include all pertinent information as to materials, gauges, finishes, fabrication, assembly, and installation.

7-5 BUILDING INSULATION, BOARD TYPE

7-5.1 General.- This section covers one type of board type roof insulation.

7-5.1.1 Preliminary considerations

7-5.1.1.1 - The provisions and requirements of the General Provisions and related documents are hereby made a part of this section of the specifications.

7-5.1.1.2 - Refer to Division 1 for additional provisions and requirements which may affect the work of this section.

7-5.2 Applicable documents

7-5.2.1 Reserved

7-5.3 Materials

7-5.3.1 Roof insulation.- Asphalt impregnated board formed of expanded perlite particles, mineral binders and glass fibers.

7-5.3.1.1 Thickness.- As noted on drawings; minimum 1 inch if not noted.

7-5.3.1.2 Edges.- Square.

7-5.3.1.3 Size.- 24 inches wide x 36 inches long.

7-5.3.1.4 Manufacturers and types

1. "Fesco Board," Johns-Manville, New York, New York.
2. "Permalite," Perma Products, Great Lakes Carbon Corporation, New York, New York.
3. "Celo-Therm," Celotex Corporation, Chicago, Illinois.

7-5.4 Installation

7-5.4.1 - Install insulation board over clean roof deck in accordance with insulation manufacturer's specifications for type of deck being covered.

7-5.4.2 - Apply insulation boards with long joints continuous and short joints staggered. Install water cut-offs in accordance with manufacturer's recommendations.

7-5.4.3 - Insulation shall not be left exposed to weather. No more insulation shall be applied than can be completely covered with roofing on the same day.

7-5.5 Quality assurance provisions

7-5.5.1 Manufacturer's literature.- Four weeks prior to the start of roofing work, submit triplicate copies of board roof insulation manufacturer's printed specifications and installation instructions for review by Contracting Officer.

7-5.5.2 Coordination.- Coordinate work of this section with work of other sections as necessary to obtain a proper installation of all items.

7-5.5.3 Samples.- Refer to Division 1 for submittal requirements and procedures.

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7-7 FACING PANELS

7-7.1 Preliminary considerations

7-7.1.1 - This Section covers dark black finish aluminum facing panels and plastic faced sandwich panels, complete. #

7-7.1.2 - The provisions and requirements of the General Provisions and related documents are hereby made a part of this section of the specifications.

7-7.1.3 - Refer to Division 1 for additional provisions and requirements which may affect the work of this section.

7-7.2 Applicable documents

7-7.2.1 Reserved

7-7.3 Materials

7-7.3.1 Aluminum alloys. - Alloys shall be at least equivalent in ultimate tensile, yield and shear strengths to Alcoa 6063-T5 alloy.

1. Minimum thickness: 0,1250 inches for all structural components.
2. Finish: Shall be black anodic finish aluminum as specified under Division 5, Section 6 - Metal Finishes.

7-7.3.2 Fasteners

1. All fasteners used in conjunction with the work of this section shall be aluminum or non-magnetic stainless steel.
2. Exposed fasteners shall match color of aluminum finish specified in paragraph 7-7.3.1 above.

7-7.3.3 Miscellaneous

7-7.3.3.1 Steel. - All miscellaneous steel used in connection with the work of this section shall be of sufficient strength to perform the functions for which intended. Miscellaneous steel shall conform to ASTM 36.

7-7.3.3.2 Plastic facing material

1. Material shall be an acrylic modified polyester gel and/or a pigmented polyester resin reinforced with glass matting or other as approved by Contracting Officer.
2. Color: White or off-white. Submit sample of color for approval prior to fabrication. #

7-7.3.3.3 Core material and/or panel insulation

1. U-Factor of insulated panels (including facing): 0.15.

2. Material: Polystyrene or polyurethane foam or rigid glass fiber. At Contractor's option, core for plastic faced panels may be honeycomb construction if structural and microwave performance requirements are met.

#

7-7.3.4 Sound-deadening material

1. Location: Backs of all un-insulated metal facing panels.

2. Material: Shall be non-flowing type comparable to 3M Company's coating EC-549. Apply to thickness of approximately 1/8 inch.

7-7.3.5 Sealants, gaskets and seals. - Gasket, seals, sealants and tapes at facing panel construction: As recommended by facing panel manufacturer and as approved by Contracting Officer for condition of use.

temperature range of 170°C F., without causing buckling, opening of fixed joints, undue stress in fasteners, leakage, and/or other detrimental effects.

7-7.4.13.3 - Facing panels and supports for same shall be designed and fabricated so that deflection (in inches) of any panel and/or framing member in a direction normal to the plane of the panel and/or member shall not exceed L/180 of the panel and/or member's clear span. Panels shall not vibrate or flex under wind loadings below 40 psf. Copies of all structural calculations made in connection with the shop detailing of the work shall be furnished to the Contracting Officer at time of shop submittal. Component parts and panels shall be designed, fabricated and installed to withstand a wind load normal to the plane of the panel as follows:

1. Panels located within 30' of grade: 40 psf.
2. Panels located between 30' and 50' of grade: 45 psf.
3. Panels located between 50' and 100' of grade: 50 psf.
4. Panels located between 100' and 160' of grade: 50 psf.
5. All panels above 160' of grade: 65 psf.

7-7.4.13.4 Water infiltration. - Provisions shall be made to drain to the exterior face of the members any leakage of water occuring at joints and/or any condensation taking place within the assembly.

7-7.4.14 Fabrication and assembly - general

7-7.4.14.1 - Dimensions shown on approved shop drawings shall be verified at the project site before fabricating materials to insure proper coordination and fit.

7-7.4.14.2 - Before being fabricated, all material shall be straightened by methods that will not injure it. After punching or working of the component parts of a member, all twists and bends shall be removed and surfaces thoroughly cleaned before assembly.

7-7.4.14.3 - Members and sections shall be sizes, weights, shapes and arrangements indicated on the drawings as a minimum and shall be closely fitted, and finished true to line and in precise position as necessary to permit accurate erection and proper joining of parts in the field.

7-7.4.14.3.1 - Contractor note: Panels shall be curved in true arcs in the horizontal plane to conform to the building radius as indicated on the drawings.

7-7.4.14.4 - Shop assembled connections shall be welded where possible. Field connections may be welded, bolted, or screwed as necessary, and all such connections shall be made in accordance with best construction practice. Work shall be designed and fabricated to support all dead and life loads specified, indicated and/or reasonably and normally anticipated. Sizes of all items shown and/or specified are minimum sizes and shall be increased as necessary to accommodate design loading and encountered and/or anticipated conditions.

7-7.4.14.5 - Exposed work shall be carefully matched to produce continuity of line, color and design. Joints in exposed work shall be accurately fitted and rigidly secured with hairline contacts. Joints shall be designed to be

7-7.4.18 Aluminum finishes. - Dark black anodic in accordance with requirements of Division 5,Section 6 - METAL FINISHES .

7-7.4.19 Plastic faced sandwich panels. - Units shall be as manufactured by Electronic Space Systems Corporation, West Concord, Mass., or Andrew Corporation, 10500 W. 153rd Street, Orland Park, Illinois, or other as approved by Contracting Officer. Units shall be designed and constructed to provide the following performance characteristics within the limits listed:

7-7.4.19.1 - Decibel loss thru assembly (with finished color coats and/or paints applied): Maximum of two decibels at frequency ranges of 7.125 to 8.4 GHz and 13.7 to 14.5 GHz.

7-7.4.19.2 Stiffness. - Panels shall support uniform load as specified under paragraph B1b (3)(a) above with a deflection limit of L/180 and shall not vibrate or flex under wind loadings below 40 psf. Panels shall also have sufficient strength to withstand 1½ times the design load and recover completely when the load is removed. Concealed vertical metal stiffeners or mullions may be used to accomplish stiffness requirements if located at 1/3 points only; horizontal metal stiffeners or mullions not permitted except at head and sills.

7-7.4.19.3 Water tightness. - Refer to paragraph A2e(1)(b) above.

7-7.4.19.4 - Resistance to crazing, fading and/or discoloration of facing material: Shall not require maintenance for minimum of 10 years. #

7-7.5 Quality assurance provisions

7-7.5.1 Samples. - Submit duplicate 24" x 24" corner samples of each type facing panel sealants along with the aluminum finishes specified herein showing color and color range proposed for use on this project. Aluminum samples shall be clearly marked as to type of alloy, finish, weight, and thickness of anodic coating and color.

7-7.5.2 Submittals

7-7.5.2.1 - Refer to Division 1 for submittal requirements and procedures.

7-7.5.2.2 - Shop drawings are required, complete, for all work of this section.

1. Show full and complete details of each type facing panel system, related construction, and general layout and elevations of all work of this section.

2. Show types, gauges, thicknesses, profiles, anchorages, hardware, fasteners, reinforcements, and finishes of all materials to be incorporated in the facing panel systems proposed for this project.

3. Verify job conditions affecting work of this section and obtain all available measurements covering all parts thereof for incorporation into shop drawings.

4. Begin fabrication only after receiving approved shop drawings.

7-7.5.3 Certificates. - Refer to Division 5, Section 6, Metal Finishes.

7-7.5.4 Warranty. - Submit written warranty, in approved form, for the following listed time periods:

7-7.5.4.1 - Metal finishes: 5 years in compliance with the requirements of Division 5, Section 6, Metal Finishes.

7-7.5.4.2 - Water infiltration (leakage): One year. The term water infiltration (leakage) as used herein shall be taken to mean the infiltration of water, dampness and/or moisture from exterior surfaces to the interior surfaces of the building enclosed thereby. Discoloration, disintegration and/or corrosion of plaster, paint, interior materials and/or the presence of efflorescence and/or mildew on interior surfaces (where such moisture is not due to condensation) shall be taken as evidence of water infiltration (leakage). Contractor does hereby guarantee all interior surfaces against depositing of moisture by infiltration and that if it should occur, he will take immediate and appropriate steps to remedy the condition promptly repairing or replacing in an acceptable manner all material damaged by water infiltration (leakage) during the warranty period.)

8-3.4.3.3 - Assembly shall be fabricated and installed so that the finished work will not be distorted and/or the fasteners overstressed by expansion and/or contraction of the metal and/or glass.

8-3.4.3.4 - The finished work shall be strong and rigid, neat in appearance and free from defects.

8-3.4.3.5 - Faces of metal in contact shall have hairline metal-to-metal joints. Insofar as possible, all work shall be assembled with concealed fittings and fastenings. All miters shall be cut and finished to a perfect fit.

8-3.4.3.6 - Members built up of drawn or extruded metal shall be held together at end joints by concealed sleeves of similar shape, welded in place. Such joints shall allow sufficient room for expansion.

8-3.4.4 Design and performance criteria

8-3.4.4.1 Conformity with local codes.- As a minimum requirement, all work of this section shall conform to applicable requirements of the Uniform Building Code, latest edition.

8-3.4.4.2 Provisions for thermal movement.- Provide for such expansion and/or contraction of the component parts as will be caused by an ambient temperature range of 170° F., without causing buckling, opening of fixed joints, undue stress on fasteners, leakage and/or other detrimental effects.

8-3.4.4.3 Stress.- All aluminum members shall be designed and fabricated for a fiber stress of 13,000 psi based on a minimum yield of 16,000 psi. The deflection (in inches) of any metal framing member in a direction normal to the plane of the wall shall not exceed 1/360 of the member's clear span. Component parts including glass shall be designed, fabricated and installed to withstand wind loads normal to the plane of the glass as follows:

1.	Window wall located within 30' of grade	40 p.s.f.
2.	Window wall located between 30' and 50' of grade	45 p.s.f.
3.	Window wall located between 50' and 100' of grade	50 p.s.f.
4.	Window wall located between 100' and 160' of grade	55 p.s.f.
5.	Window wall located above 160' of grade	65 p.s.f.

8-3.4.4.4 Calculation.- Copies of all structural calculations made in connection with the shop detailing of the work shall be furnished to the Contracting Officer at the time of shop drawing submittal.

8-3.4.4.5 Water infiltration.- Provisions shall be made to drain to the exterior face of the members any leakage of water occuring at joints and/or any condensation taking place within the assembly.

8-3.4.4.6 Thermal conduction.- All interior aluminum members of the wall shall be thermally isolated from all exterior aluminum members by the use of non-conductive isolators not less than 0.125 inches thick or by other means acceptable to the contracting officer.

8-3.4.5 Fabrication and assembly.- General practice:

8-3.4.5.1 - Dimensions shown on approved shop drawings shall be verified at the project site before fabricating materials to insure proper coordination and fit.

8-4 GLASS AND GLAZING

8-4.1 Preliminary considerations

8-4.1.1 - The provisions and requirements of the General Provisions and related documents are hereby made a part of this section of the specifications

8-4.1.2 - Refer to Division 1 for additional provisions and requirements which may affect the work of this section.

8-4.1.3 - This section contains general specifications pertaining to all glass and glazing work throughout the project, except where such materials and/or their application may be otherwise specified in other sections, and becomes a part of all sections containing reference to this section and where materials of the types specified in this section are required by the drawings, with the same force and effect as if written in full in each section. In particular, this section is written as an adjunct to work of Division 8, Section 3, Window Wall Construction.

8-4.2 Applicable documents

8-4.2.1 Reference specifications and standards.- Perform all work of this section in strict accordance with the following reference specification and standard which is hereby made a part of these specifications as if fully set forth herein.

8-4.2.1.1 - "Glazing Manual" issued by the Flat Glass Marketing Association, 2217 Tribune, Chicago, Illinois; latest edition.

8-4.2.2 - Reserved

8-4.3 Materials

8-4.3.1 Glass.- As a minimum requirement for work of this project, glass shall comply with, and be graded in compliance with the requirements of Federal Specification DD-G-451c and shall additionally comply with quality requirements as set forth below under "Glass Types" and under paragraph "Manufacturing, Fabrication and Performance Requirements."

8-4.3.1.1 Glass types

a. Polished Plate (Twin Ground)

1. 1/4 inch clear, glazing quality.

b. Heavy Duty Polished Plate (Twin Ground)

1. 1/2 inch clear, commercial quality
2. 7/8 inch clear, commercial quality

8-4.3.1.2 Manufacturing, fabrication and performance requirements.- Edges shall be provided in accordance with manufacturer's recommendations and reference specifications, subject to approval of Contracting Officer.

8-4.3.2 Custom mirrors.- Shall be 1/4 inch polished plate glass, No. 1 mirror glazing quality, unless otherwise indicated, and have all exposed edges polished and beveled where indicated.

8-4.3.2.1 - Setting clips for custom mirrors shall be subject to Contracting Officer's selection and approval.

APPENDIX II

ENGINEERING REQUIREMENT FAA-ER-440-029

Engineering Requirement FAA-ER-440-029 and Change 1 thereto provided the basic technical criteria for the national standard ATCT designs including the airport traffic control tower design. FAA-ER-440-029 is provided as part of this Engineering Standard for background information.

FAA-ER-440-029
CHANGE-1
5 April 1974

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION ENGINEERING REQUIREMENT

MAJOR ACTIVITY LEVEL AIRPORT TRAFFIC CONTROL TOWER

ARCHITECT - ENGINEER DESIGN

This change forms a part of FAA-ER-440-029, dated 13 March 1970.

PURPOSE: Since the issuance of FAA-ER-440-029 in 1970 and the subsequent construction of the Dallas-Forth Worth facility a number of changes, revisions, etc. have been made to the original engineering requirement. The following is a list of these changes:

Page 1, paragraph 1.1: The North Central Texas Regional Airport (NCTRA) is now referred to as the Dallas-Fort Worth Regional Airport.

Page 2, paragraph 2.1.1: Specification Number 6000.7A should read 6000.7B.

Page 2, paragraph 2.1.4: Specification FAA-D-2160a should read FAA-D-2494/1 & 2. Specification FAA-E-2328 should read FAA-E-2470.

Page 4, paragraph 3.3 b: The requirement that the specifications format be in accordance with FAA-STD-005b was waived.

Page 6, paragraph 4.5.6: An access door from the cab stairway to the cab walkway was not provided.

Page 8, paragraph 4.6: The A-E developed a concept that placed all the microwave equipment on one level in lieu of the two levels called for in this paragraph. This design was termed the "shaft with microwave level" as opposed to the "shaft without microwave level" which provided the two enclosed levels below the junction space.

Page 9, paragraph 4.6.2: The weather bureau level at the Dallas-Fort Worth facility was deleted. This requirement has also been deleted from the National Standard Design.

Page 9, paragraph 4.6.3.1: An elevator landing or access to the elevator shaft was provided at 30' intervals in lieu of 45' intervals.

Page 10, paragraph 4.6.6, line 21: Grating clearance is 6" in lieu of 9".

Page 17, paragraph 5.2: Alternate designs of shaft/base building interface were not provided by A-E.

Page 20, paragraph 6.12: A 5' x 7' elevator platform was provided in lieu of 5' x 6'.

Page 21, paragraph 7.2 c: Item c should read FAA-D-2494/1 & 2 in lieu of FAA-D-2160.

Page 27, paragraph 8.4.1, line 15: An alternate junction room layout was not provided.

Page 29, paragraph 10: The requirement that the specifications format be in accordance with FAA-STD-005b was waived.

FAA-ER-440-029
13 March 1970

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION ENGINEERING REQUIREMENT

MAJOR ACTIVITY LEVEL AIRPORT TRAFFIC CONTROL TOWER ARCHITECT-ENGINEER DESIGN

1. SCOPE

1.1 Scope.- This sets forth the engineering requirements for the development of an architect-engineer (A-E) design for a major activity level airport traffic control tower to serve the North Central Texas Regional Airport (NCTRA). In addition, this engineering requirement provides for the development of national standard Airport Traffic Control Tower (ATCT) shafts and a cab for major activity level airports.

2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The following FAA orders, standards, drawings, and specifications of the issues specified in the contract form a part of this engineering requirement and are applicable as specified herein.

2.1.1 FAA orders

AF P 6510.16	Air Traffic Control Tower Siting Criteria
OA P 1600.6	Protection of Agency Property
6010.4	Engineers Cost Estimates for Construction of FAA Facilities

4402.1	Federal Aviation Agency Procurement Manual, Construction and Architect-Engineering Services, Part 2-18
6000.7A	Improvement of Operating Conditions at TRACON Facilities
4660.1	Real Property Handbook
6900.1	Abatement and Control of Pollution, Natural Water Resources
6950.9	Facility Emergency Lighting
4620.4	Use, Replacement and Rehabilitation Standards

2.1.2 FAA standards

FAA-STD-002	Federal Aviation Agency Standard for Engineering Drawings
FAA-STD-003	Paint Systems for Structures
FAA-STD-005b	Preparation of Specification Documents

2.1.3 FAA drawings

Air Traffic Control Tower Cab C-1 Sheets 1-16, Cab C-2 Sheets 20-24, Cab C-2A Sheets 30-33.

2.1.4 FAA specifications

FAA-C-1217c	Electrical Work, Interior
FAA-D-2160a	Instruction Books, Electrical and Mechanical Equipment
FAA-E-2223a	Floor System, Raised
FAA-E-2328	Plastic Window Shades
FAA-E-2132	Intercom System General Purpose
FAA-E-2204	Engine-generator Sets, 5KW to 300 KW

2.1.5 Source of FAA documents.- The FAA documents cited above may be obtained from the Contracting Officer in the Federal Aviation Administration office issuing the contract. Requests should fully identify the material desired and should cite the contract involved and use to be made of the requested material.

2.2 Other publications

2.2.1 Uniform Building Code Volume I, current edition.- International Conference of Building Officials, 50 South Robles, Pasadena, Calif. 91101.

2.2.2 Heating, Ventilating, Air Conditioning Guide.- American Society of Heating, Refrigeration and Air Conditioning Engineers, 234 Fifth Avenue, New York, N. Y.

2.2.3 National Electrical Code.- Publication No. 70, National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110.

2.2.4 National Plumbing Code.- Publication No. A40.8, United States of American Standards Institute, 10 East 40th Street, New York, New York.

2.2.5 IES Handbook.- Illuminating Engineering Society, 1860 Broadway, New York, New York.

2.2.6 Code on Lighting Protection Systems.- UL96A, Underwriters Laboratories Inc., 161 Sixth Avenue, New York, New York.

3. GENERAL REQUIREMENTS

3.1 Services to be performed.- The A-E shall develop a design for the major activity level airport traffic control tower to serve the NCTRA. This design shall consist of a 180' shaft (measured from floor of base building to cab floor), a base building, and an eleven-sided control cab. The national standard designs shall consist of three shafts (180', 150', 120') and an octagonal cab. A base building for the national standard shall not be part of this effort.

3.2 Documents to be furnished.- The A-E shall conceive, develop, and prepare the following documents in accordance with the requirements specified herein.

a. NCTRA Working Drawings - separate set of drawings shall be prepared for each of the following:

- 180' NCTRA shaft and Weather Bureau
- 11-sided cab
- base building

b. National Standard Working Drawings - separate sets of drawings shall be prepared for each of the following:

- 180' shaft
- 150' shaft
- 120' shaft
- octagonal control cab
- C-2 control cab (revisions)

c. Site Adaption Handbook for the national standard designs.

The following documents shall be prepared for the NCTRA design, and separate sets shall be prepared for the national standard designs:

d. construction specifications

e. engineers cost estimates

f. mechanical/electrical systems reference handbook

g. design data handbook (NCTRA only)

3.3 Design utilization.- The NCTRA design will be constructed on a site selected by the FAA on the North Central Texas Regional Airport based on the siting requirements in FAA Order AF P 6510.16. A plot of the site showing boundary lines and corners along with the tower cab location and orientation will be furnished to the A-E.

The national standard designs will be site adapted by the FAA for locations throughout the contiguous United States and the construction contracts will be administered by the FAA. The designs shall be completely responsive to the utilization factors stated above, therefore:

a. The national standard drawings and specifications shall require minimal changes in order to adapt them to local site requirements.

b. The national standard drawings, specifications, and engineering cost estimates shall comply with the applicable requirements of FAA-STD-002, FAA-STD-005b, FAA Procurement Manual (Part 2-18), and FAA Order 6010.4.

c. The designs shall be such that facilities constructed from the designs shall require minimal maintenance.

d. The standard engineers cost estimates shall provide all basic construction cost data for the development of a project cost estimate for sites throughout the contiguous United States. The base building (s) for the national standard design will be designed by FAA for all locations except for the NCTRA.

3.4 Operational environment.- The major activity level ATCT will be applicable for airports with 100,000 annual instrument operations or greater, and where Airport Surveillance Radar (ASR) service is available. In addition, Precision Approach Radar (PAR) and Airport Surface Detection Equipment (ASDE) may be available. Airports with annual instrument operations between 75,000 and 99,999 may also be considered for a structure of this type. As such, the airport would serve a large city or populated area. Most of these ATCTs will be operating around-the-clock. The designs developed under this engineering requirement shall be compatible with this type of airport environment.

4. ARCHITECTURAL REQUIREMENTS

4.1 Code.- A building code is being prepared for use on all structures constructed at the NCTRA. If the building code is not available on time for use by the A-E, then the Uniform Building Code shall be used. See Section 8 for national standard designs.

4.2 Appearance.- The exterior of the NCTRA ATCT shall be aesthetically compatible with the other airport structures. Interior decor and furnishings shall be in general accord with Order 4660.1, Chapter 3, "Real Property Handbook" and Handbook 4620.4, "Use, Replacement and Rehabilitation Standards." A furniture plan and a color perspective showing partition layouts shall be furnished for the base building. All painting shall be in accordance with FAA-STD-003. A table of all furniture required shall be prepared for agency use in making a cost estimate. The A-E shall develop requirements for the areas not specified in the above handbooks.

4.3 Security.- Security features shall be provided in accordance with OA P 1600.6. All door locks shall be provided with construction cores. The lock system shall be an extension of the existing FAA system.

4.4 Fire protection.- The ATCT shall be constructed from incombustible materials. The stairway from the cab shall be enclosed to the ground exit. The stairway along with any connecting corridors to the ground exit shall be constructed to afford a fire resistence rating of not less than 2-hours.. Refer to Uniform Building Code.

4.5 Control cab.- The control cab serves as a vantage point from which the air traffic controller may obtain an unobstructed view of air traffic patterns around the airport, all operational movement areas of ground traffic, and permits as good a visual depth perception at the extreme end of the runways and taxiways as possible considering the magnitude of major activity airport size and configuration.

4.5.1 Size and shape.- The NCTRA cab shall be 11-sided. The cab shall have a minimum floor area of 400 square feet exclusive of the area taken up by the stairwell.

4.5.2 Cab floor.- The cab subfloor shall support a raised floor. The floor shall provide maximum access to underside of consoles. The raised floor shall be in accordance with FAA-E-2223a. The raised floor panels shall be carpeted within the operations area.

4.5.3 Cab walls.- The cab walls above and below the window head and sill shall be heavy gauge removable metal panel with sound absorbent backing. The finish of any interior exposed wall surface shall be a uniform medium intensity color with low reflectance value,

preferably a dull black. The exterior of the cab shall be finished with a flat black exterior type paint. The cab wall above the glass shall be sloped in the same plane as the cab glass. The lower section of about three feet shall be vertical.

4.5.4 Cab sill.- The cab sill shall be of minimum thickness to accommodate insulation, and if air conditioning is supplied or returned along the sill, include this in the sill area. The cab sill height shall not exceed 36-inches and preferably be less to suit the conditions outlined in paragraph 4.5.5. Outside surface shall be sloped for drainage. Inside surface to be finished flush with the interior wall.

4.5.5 Cab consoles.- The console desk design is under study at the present time. When the console design is completed it will be furnished the A-E to detail into the plans. The base of the consoles will contain shielded theater-type floor lighting with variable intensity controls. Separate designs will be furnished for NCTRA and the standard. The A-E shall design the circuitry to the consoles.

4.5.6 Cab stairway.- The cab stairway connects the junction room to the control cab. The stairway opening to the cab shall be located at the rear of the cab. The stairway should be similar to a ships ladder to keep the cab opening at a minimum. The doorway leading to the cab stairway shall be a self-closing fire resistant door having a minimum 2-hour fire rating. The stairway shall have a handrail on at least one side, and the upper entrance at the cab level shall be provided with a gate. Stairway headroom shall be not less than 7'-0" vertically nor less than 5'-6" perpendicular to a line paralled to the stair slope. Riser height should not be less than 7" nor more than 9", treads shall not be less than 8" nor more than 10" excluding nosing. Provide variable intensity theater-type shielded floor lighting in the stairway. This lighting shall be connected to the standby power system.

Provide an access door from the stairway to the cab walkway. Head of door shall not extend above cab sill and the base of the door shall not extend below cab walkway elevation.

4.5.7 Cab columns.- The number of cab columns shall not exceed the number of sides of the cab. The columns supporting the cab roof shall not exceed $4\frac{1}{2}$" x 8" (w x d). The A-E shall use every means available to minimize the size of columns including the use of high strength steel.

4.5.8 Column raceway.- In addition to providing the roof support, the columns shall be used for roof drain, sanitary vent, power cable, antenna cables, and grounding systems. Column used for the roof drains shall be designed such that freezing or rusting from the inside or sweating from the outside will not occur. Column used

for sanitary vent shall not feed into the cable raceway on cab roof. Minimum inside dimensions shall be $3\frac{1}{2}$" x 5" (w x d) to provide space for cabling and piping. Four of the columns shall have 2" x 5" access slots provided above the hung cab ceiling to permit wire runs to ceiling lights. One column shall have a 2" x 5" access slot at the cab desk level which opens into a 6" x 6" junction box with removable cover in the wall to permit wire runs from cab ceiling to be wired to cab desk controls. The base of all columns shall extend into the junction room below the cab terminating with end open and free to accept piping or antenna cable runs to cab roof, or provisions made to receive the cable runs or piping in the columns in the raised floor section utilizing slots in the columns.

4.5.9 Cab glass.- The cab glass design shall provide maximum visibility. The glass shall be dual pane polished plate glass or float glass with hermetically sealed air space. The glass shall be free from distortion. The A-E shall make every effort to obtain information from manufacturers to provide the maximum size glass panels available that meet the above requirements. Every effort shall be made to reduce glare and reflections on the cab glass and corners. A study is presently underway regarding the reduction of glare, reflection, and heat transfer for ATCT cab glass. Progress reports of this study will be furnished to the A-E as the project develops.

4.5.10 Cab mullions.- The mullions shall be designed with the minimum cross section for glass support allowable considering the wind loading requirements. The finish color of mullions and columns shall be a non reflective light intensity color.

4.5.11 Ceiling.- The clear ceiling height from the cab operating floor to the ceiling shall be 10 to 12 feet depending upon the size of glass panes available (reference 4.5.9). The ceiling may slope up at the outer area to enhance the controller's upward visibility from the opposite side of the cab. The ceiling shall be designed at the outer edges so that window shades and all fixtures as specified in Specification FAA-E-2328 may be installed. The minimum clear space from the ceiling to any supporting members shall be 15". The ceiling shall be removable acoustical fiberglass type panels supported by an adjustable suspended metal support grid. Joint lines shall be kept to a minimum. Provide traffic signal light gun mounting boxes installed flush with the ceiling. Provide a twist lock convenience outlet in the mounting box of the traffic signal light gun. The locations and detail of the light gun(s) will be furnished by the FAA. The cab ceiling shall be a charcoal gray.

4.5.12 Roof.- The roof shall be a built-up roof with insulation. The roof shall be built to the requirements of a 20-year bondable roof. A concealed telescoping type ladder shall be installed in the cab ceiling with a roof access hatch above to provide access

to the roof from the cab operating floor. The roof shall be sloped to prevent rain water from flowing off the sides of the roof. A storm drain shall be provided to drain the roof. The parapet may be built-up to serve as the guard rail for the cab roof or a metal guard rail system may be installed.

An antenna raceway is required around the perimeter of the cab roof to route cables to the communications antennas and lightning rods which are mounted on the raceway. The antenna raceway shall provide a space of approximately 4" x 6". Feeder raceways with a minimum of 12 square inches inside area shall be provided to connect the cab column raceway to the antenna raceway. 4" x 6" access plates shall be provided on the opposite side or bottom of the antenna raceway at each feeder raceway entrance, and each antenna or lightning rod mount. The antenna raceway shall be 3'-6" above the roof elevation. If the roof parapet serves as the guard rail, a separate antenna raceway shall be provided. If a guard rail system is provided, the antenna raceway may be incorporated into the top member of the guard rail or provided separately.

The antenna mounts shall be at least eight feet apart and shall be threaded two inch pipe couplings to accommodate the standard antenna mounts, maximum antenna height will be 12-feet above base The number, location, and height of the lightning rods shall be as required by Underwriter's Laboratories, Inc., "Master Labeled Lightning Protection Systems."

4.5.13 Walkway.- A walkway is to be provided around the exterior of the control cab to facilitate washing cab windows. The walkway shall be located at a sufficient elevation below the cab to permit the controllers a close-in view of the field unobstructed by any railing. The walkway should be at least 24-inches below but not greater than 48-inches below the cabfloor level. Provide access door from stairwell to walkway as referenced in 4.5.6.

4.6 Tower shaft.- The tower shaft serves as a supporting structure for the tower cab as well as an enclosure for the various cable runs, piping, elevator, and stairway to the cab. Under the cab shall be three floors, one for the junction space with a clear height below any ductwork, lights, etc. of 9'-0", and two for microwave equipment with clear ceiling heights of 11'-0". The exterior walls between these three floors shall be steel framework enclosed with plastic or dark glass or possibly spandrel glass. The material shall cause less than 1 decibel loss to the microwave signal. The exterior walls shall provide radio frequency visibility within the total circumference for illuminating the antenna dishes. The A-E shall furnish recommendations for glass type for FAA evaluation as a basis for final design.

The A-E shall make every effort to insure that the exterior appearance of these 3 floors blends in well with the exterior appearance of the remainder of the shaft and the cab.

4.6.1 Base level.- The base level of the tower contains the stairway and elevator entrance, and provides access to the cable and pipe chase.

4.6.2 Weather Bureau level.- The NCTRA shaft shall provide space for Weather Bureau operations. This space shall be provided on one floor a minimum of 60' up the shaft. The areas required for the Weather Bureau functions are as follows:

a. operations area (equipment) - 610 sq. ft.
b. officer-in-charge - 260 sq. ft.
c. restroom - 90 sq. ft.
d. ready room - 175 sq. ft.
e. storage - 310 sq. ft.
f. electrical technician - 350 sq. ft.
g. communications (equip.) - 350 sq. ft.

The minimum required ceiling heights are 9' in office areas and 10' in equipment areas. The A-E shall develop finish requirements for these areas. To meet space requirements, the A-E shall enlarge the shaft cross-section at this floor level. Include maximum window areas at this level.

4.6.3 Microwave level.- The microwave level shall house the microwave equipment and the antenna dishes.

4.6.3.1 Elevator landing.- Elevator landings shall be provided approximately every 45' throughout the tower shaft in addition to a landing at the Weather Bureau level. The lower floor of the microwave level shall be the last level available for access to the elevator. This will provide sufficient overrun area above the elevator as required.

4.6.3.2 Equipment lift.- The lower floor of the microwave level shall be the bottom level for the equipment lift. The equipment lift shall be directly across from the elevator. Reference 6.13.

4.6.3.3 Equipment space.- Each microwave level shall have sufficient space to accommodate at least nine equipment racks (20"D x 20"W x 7'H) and three battery racks (20"D x 3'W x 6'H). Layouts will be furnished by FAA.

4.6.4 Junction space.- The space below the cab commonly called the junction space shall house the condensing unit and air handling unit for the heating and cooling of the cab, microwave level, and junction space. In addition, the junction space shall be utilized for recording equipment, cable convergence or termination, access to the space under the console desks, and toilet areas. The toilets (men/women) for the junction room shall be of minimum size. Batteries for the cab D.C. power system shall be located in the junction space. The A-E shall provide a ventilation system for the batteries.

4.6.5 Cab mounting platform.- The cab mounting platform shall be designed to receive all cabs developed under this engineering requirement. The A-E shall modify the C-2 cab design drawings as required to make it compatible with the mounting platform. In addition, the A-E shall provide junction room alternates in the tower shaft to accommodate the C-2 stairway.

4.6.6 Cable chase.- The cable chase provides a means of routing power and control cables from the base building structure to the rooms below the cab from the radio equipment, recorder equipment, TELCO equipment, radar equipment, and TRACON room. Also, commercial and standby power cabling, and all navigational aids and airport lighting cabling located on the airport shall be contained in the chase. One of the cable chase walls shall be used for air conditioning and heating pipe runs to the cab air handling unit. The cable chase shall be so located in the tower shaft that the cabling distance to the equipment rooms in the base structure shall be minimized. The useable cable chase perimeter should be approximately 16 linear feet. This should be in two separate chases so that the control cable and power cable runs will be in a separate chase thereby requiring no divider wall or metalic enclosure. The door to the cable chase shall be a self-closing metal door. At each access level the door shall be located on the same side of the chase. Access to the cable chase doors shall be from the tower stair landing. Access door spacing shall not exceed 15-feet throughout the height of the tower shaft. The cable chase shall have steel grating at each access point. Grating shall extend from the access door to not less than nine inches off all inner-wall surfaces except as required for structural support. Provide horizontal flush-mounted cable supports on the chase walls for supporting vertical cable runs. The supports shall be provided one-foot above steel floor grating and approximately midway between the upper and lower floor levels. Knockout panels or similar capabilities in the cable chase wall shall be provided for access into or out of the cable chase with cable runs. These shall be located below ceilings (above ceilings if suspended and accessible) and adjacent to equipment rooms for as near a direct access from equipment to the shaft as possible. This applies to both the power and control cable runs. Incandescent lighting shall be provided at each access level in the chase.

4.6.7 Shaft stairway.- A stairway shall be provided to connect the ground level entrance of the tower shaft to all intermediate floor levels and shall terminate at the junction room level. Stairwell headroom shall be kept to a minimum, but not less than 7'-0" vertically nor less than 5'-6" perpendicular to a line parallel to the stair slope. Riser height shall not exceed tread dimension excluding nosing. Riser height shall not be less than 7" nor more than 9". Treads shall not be less than 8" nor more than 10" excluding nosing. Provide at least one handrail for the stairwell and provide non-skid surfacing on the stairs. Sufficient lighting shall be provided to make the stairwell safe. This lighting shall be connected to the standby power system.

4.7 Base building.- The following paragraphs contain the requirements and functions of the various rooms in the NCTRA base structure. The size and location of all rooms shall be as shown on Table I.

4.7.1 Radio equipment room.- This room contains the electronic equipment racks necessary to provide radio communication between the controllers and pilots.

4.7.7.1 Location.- The cable distance from the equipment room to the cab roof antennas is critical and should be held to a minimum.

4.7.1.2 Shape.- The equipment racks required for this function are approximately 22" x 22" x 84" high. In order to obtain the clearance required for maintenance access to front and rear of the equipment racks, the minimum room width for two rows of equipment racks is 17-feet. This dimension may be increased in increments of 7-feet to accommodate additional rows of equipment racks. The clearance around the ends of the rows of equipment racks shall be 4'-0". The number of racks will be furnished by FAA with typical layout.

4.7.1.3 Ceiling.- If the A-E provides a suspended ceiling within this room as part of the mechanical system (such as air plenum) or room treatment for the purpose of aesthetics or acoustical qualities, the ceiling is to be removable in order to gain access to the cabling in this area. Provide a minimum of 9-feet clear space above the floor level, clear of air conditioning ducts, lights, etc. Ceiling air conditioning outlets and lighting fixtures shall be located between the rows of equipment racks. Align air conditioning returns over rows of equipment racks.

4.7.1.4 Terminal cabinets.- Provide two 30" x 36" x 6" (h x w x d) terminal cabinets in equipment room wall near the cable shaft with cable ladder and tray for access to the cable shaft. One cabinet is to be designated as "Remote Facilities Terminal Cabinet" and the other "Telco Demarcation Cabinet." The telco cabinet shall have 3/4" plywood backing. Provide power panel in accordance with electrical section.

4.7.2 Radio shop and storage.- These areas shall be provided for performing the necessary maintenance and storage related to radio communication equipment.

4.7.2.1 Shop.- In one area of the shop, provide space for a 4' x 7' workbench and mobile electronic test equipment. Provide convenience outlets on a separate circuit 48" above the floor. See electrical section.

4.7.2.2 Storage.- Storage shelves and bins shall be provided on three walls. These shelves and bins are to be the adjustable type 18" deep.

4.7.3 Radar equipment room.- This room contains the equipment racks and ancillary equipment necessary for radar surveillance of air traffic at the airport and in the terminal area.

4.7.3.1 Location.- The cable distance for radar electronic equipment is critical; therefore, the cable distance from the radar equipment room to the TRACON room and the cab should be held to a minimum.

4.7.3.2 Shape.- In order to obtain the clearance required for maintenance access to the front and rear of equipment racks, the minimum room width for two rows of equipment racks is 19-feet. This dimension may be increased in increments of 7-feet to accommodate additional rows of equipment. The clearance around the ends of the rows of equipment racks shall be 4'-0". The number and size of racks will be furnished by the FAA with typical layout.

4.7.3.3 Ceiling.- If the A-E provides a suspended ceiling within this room as part of the mechanical system or room treatment for the purpose of aesthetics or acoustics, the ceiling is to be removable in order to gain access to cabling in this area. Provide a minimum of 9-feet clear space above floor level, clear of air conditioning ducts, lights, etc. Ceiling air conditioning outlets and lighting fixtures shall be located between the rows of equipment racks. Locate air conditioning system returns over equipment racks.

4.7.3.4 Equipment wall space.- Provide 60 linear feet of wall space for installation by FAA of voltage regulators, power control units, and switch boxes, etc. Locate accessible to cable chase and with common wall, if possible.

4.7.4 Radar shop and storage.- These areas shall be provided for performing the necessary maintenance and storage related to the radar electronic equipment.

4.7.4.1 Shop.- The shape of the shop shall be such that two 4' x 7' workbenches may be installed and mobile electronic test equipment utilized. Provide convenience outlets on a separate circuit 48" above the floor. See electrical section.

4.7.4.2 Storage.- Storage shelves and bins shall be provided on walls where possible. These shelves and bins shall be the adjustable type 18" deep.

4.7.5 Recorder equipment room.- This room contains the recorder equipment which automatically records radio communications between the controllers and the pilots.

4.7.5.1 Location.- The responsibility for periodic changing of the magnetic tapes is that of the controllers. Therefore, it is desirable that this area be located close to the control cab, if possible, or adjacent to the passenger elevator at a lower level.

4.7.5.2 Shape.- The racks are the same size as the radio racks indicated previously. There shall be four feet of clearance in front, rear, and at the end of rows. If two rows are required, there shall be 5-feet between parallel rows.

4.7.5.3 Other.- The area shall be accessible to the cable chase to facilitate cable runs to the control cab. If not located adjacent to cable chase, then two 2-inch conduits are required to the cable chase.

4.7.6 Telephone and equipment room.- This room contains the equipment provided by the local telephone company associated with interphone and landline communications required in air traffic control functions. This equipment is separate and in addition to the equipment required in the administrative areas. Layout of the equipment will be furnished to the A-E.

4.7.6.1 Location.- The location should be proximate to the cable chase. Provide four 3-inch conduits or cable tray to the cable chase. Access to the telephone equipment room to be through corridors. This room shall have an exterior wall.

4.7.6.2 Equipment mounting.- One wall of the telephone equipment room is to have 3/4" plywood facing to enable mounting of panels, etc., required by the telephone company. Provide a telephone demarcation box in areas requiring business telephone equipment.

4.7.7 TRACON operation room.- This room contains the radar scopes and overhead instrument consoles used in the control of air traffic under instrument flight conditions. The design of this room shall follow the criteria contained in Order 6000.7A, "Improvement of Operating Conditions at TRACON Facilities," and the guidelines stated in the following paragraphs.

4.7.7.1 Location.- The operation room shall be proximate to the elevator to facilitate movement of personnel between this room and the tower cab. The room shall be located between the radio equipment room and the radar equipment room. The console arrangement will be furnished to the A-E. In general, the consoles are placed in the wall separating the operations room from the radar room. This facilitates maintenance by allowing the mobile equipment to be brought directly into the radar equipment room.

4.7.7.2 Shape.- The shape is dictated by the console arrangement.

4.7.7.3 Ceiling.- The clear ceiling height from the floor shall be a minimum of 9-feet. The ceiling shall be suspended acoustical ceiling with a light finish. This may be placed in two levels to utilize indirect lighting to flood walls only. Provide adequate space above the ceiling for air conditioning ducts and electronic raceways as required.

4.7.7.4 Wall covering.- The walls shall be carpeted up to 42" high with wainscoting. The walls above the wainscoting should be acoustical material.

4.7.7.5 Floor.- A raised floor shall be provided as specified in 4.7.13. The raised floor panels shall be carpeted.

4.7.7.6 Lighting.- Considerable studies have been made to reduce reflections on the radar scopes due to lighting. The FAA will furnish this information to the A-E for his use. The finishes for wall and ceiling shall accommodate the lighting requirements.

4.7.7.7 Entrance doorway.- A light trap type entrance shall be provided for the operation area. This space is in addition to the space requirements shown in Table I.

4.7.8 Ready room.- The ready room provides a space to prepare simple meals, eat lunches, and to relax during off-duty break, etc. Provide an efficiency type kitchen arrangement with a rapid heat oven. Acoustical ceiling shall be provided in this area. Utilize natural window light if possible. This area should be proximate to the TRACON operations room and tower shaft.

4.7.9 Training/Conference rooms.- These rooms provide areas in which AF and AT personnel undergo intensive training. These areas double as conference rooms. The shapes shall be similar to a classroom or conference type configuration. Acoustical ceiling is required in these rooms for sound attenuation. Natural light is desired if possible. Combination magnetic chalk boards and movie screens shall be provided.

4.7.10 Engine-generator room.- The engine-generator is government furnished material. The A-E shall provide space and design details for installation as described in the following paragraphs and Paragraph 7.9.

4.7.10.1 Location and shape.- The engine-generator area is to be located on the ground floor adjacent to the electrical service vault, and in the same general area as the air conditioning equipment. The A-E shall determine the required E/G load and the FAA will furnish typical installation drawings of available equipment to satisfy the requirements. The A-E will determine the final size and shape of the room to house the equipment and provide easy access for maintenance.

4.7.10.2 Ventilation.- Provide weather-tight air intake louvers with automatic back-draft dampers. Locate to provide cross ventilation with exhaust louver mentioned below. Provide weather-tight exhaust louver with automatic back-draft dampers. Exhaust louver shall be located in the exterior wall. Bottom of louver to be 24" above floor level. Provide a sleeve for engine muffler exhaust 8'-0" above the floor level. This exhaust line shall not be located on front side of the building. All louvers and exhaust fans, in excess of 96 square inches, shall be of burglar proof construction.

4.7.10.3 Construction considerations.- The room shall have a fire rating of not less than 2-hours. The design shall consider attenuation of plant noise and vibration. Room finish shall be painted concrete surfaces. Provide double doors with opening 5' x 8' to exterior and loading dock. Provide interior door to corridor or lobby area. Door sill to be 4-inch raised concrete. Provide weather stripping for this door to prevent fumes from entering conditioned space.

4.7.10.4 Miscellaneous.- The A-E shall provide cold water tap and floor drains within this area. Provide space adjacent to the engine-generator room for an underground fuel tank with a storage capacity of 5,000 gallons. Provide 2-inch conduit for fuel lines from above mentioned fuel tank to engine-generator room. Provide raceway from electrical service vault to engine-generator room. Raceway is required for feeders to power panels referenced in the Electrical Section. Space shall be provided adjacent to the engine-generator room for an outside radiator and load bank for the engine-generator.

4.7.11 Mechanical equipment room.- This area will house the basic operating elements of the base building environmental systems. This area should be located near the engine-generato room and the electric service vault.

4.7.11.1 Mechanical control room.- Space should be provided for the AF mechanical maintenance supervisor's desk, cabinets for storage of manuals, wall space for flow charts, etc. and at least two walls with the upper 1/2 glass pane to permit viewing the mechanical equipment. This area will be utilized for monitoring of equipment, and to complete necessary logs and reports. Minimum room area shall be 150 square feet.

4.7.12 Grounds maintenance storage.- This area shall be used for storage of maintenance equipment and supplies for the building and grounds. Space shall be provided for storage racks and cabinets. This room shall have one or more exterior walls and shall have a door to the outside. A drainage basin with hot and cold tap water, convenience outlets, heating, and ventilation shall be provided in this area.

4.7.13 Electrical-mechanical shop.- This will be a common shop for electrical, mechanical, and grounds maintenance personnel. Space is required for a 4' x 7' workbench, power tools and equipment, ten personnel lockers, two wash basins, and minimum parts and tool storage. Provide an outside access door and hallway access to the elevator. Provide convenience outlets on a separate circuit 48" above the floor.

4.7.14 Provisions for handicapped persons.- In the design of the base building, consideration shall be given to handicapped persons who may move in the area. Specifically, the requirements of Chapter 13 of the Real Property Handbook (4660) shall be met.

4.7.15 Raised floor.- A raised floor system (FAA-E-2223a) shall be provided in the following areas of the base building to provide raceways for cabling and/or plenum for air supply; the radio equipment room, TRACON operations room, radar equipment room, telephone equipment room, walk area around the shaft. These areas shall be located to provide under floor cable runs between the above mentioned areas. Provide metal dividers to separate the power cables from the control cables.

4.7.16 Other architectural items.- Provide toilets adjacent to areas of personnel occupancy. A mens toilet and a womens toilet shall be located near the TRACON room. Additional toilets shall be located in the junction room area. Provide janitor closets as required with supply shelves, mop rack, and shop sink. In administrative areas, windows shall have blinds with adjustable vertical slats. Doors leading to equipment areas and shops shall have a minimum width of 3'-6".

5. STRUCTURAL REQUIREMENTS

5.1 Code.- The structural designs shall be in accordance with the requirements of Volume I, Uniform Building Code, current edition.

5.1.1 Design loads.- For the NCTRA design, design loads (dead, wind, snow, etc.) shall be determined in accordance with the Uniform Building Code for the Dallas-Fort Worth area. For the national standard design, design loads shall be selected from the Uniform Building Code which are representative for the contiguous United States.

The minimum design loads (for NCTRA and national standards) shall be as follows:

a. CONTROL CAB

1. Roof live loads: 50 psf positive and 60 psf negative pressure.
2. Wind loads: The cab as a unit shall be designed for a unit pressure of 60 psf on projected face, but any individual member in the walls shall be designed for a local suction pressure of 84 psf in a direction outward from the center of the cab floor loading.
3. Floor live loads: 80 psf plus a concentrated live load of 500 pounds at any point.

b. EQUIPMENT ROOMS: floor li ve load of 150 psf (Telco, radio, radar, microwave)

c. TRACON ROOM: floor live load of 100 psf plus a concentrated load of 500 pounds at any point.

The deflection due to live loads of floor systems in equipment rooms and TRACON room, and the floor/roof system in the cab shall not exceed 1/360 of the spans.

5.1.2 Seismic considerations.- The standard ATCT shafts shall be designed for the seismic conditions of Zone III. Also, the A-E shall prepar in the preliminary design stage an analysis to determine if alternate shaft designs for locations outside seismic Zone III areas are justified. The A-E shall submit his recommendation to the FAA for review. The NCTRA shaft shall be designed for the seismic conditions of Zone 0.

5.1.3 Foundation design.- For the NCTRA, the A-E will be furnished by the FAA soil data and topography from which he can design the foundations. For the national standard designs, an allowable soil bearing pressure of 4,000 pounds per square foot shall be used.

5.2 Control shaft/base building interface.- The shaft shall have the capability of being orientated with respect to the base building in four different horizontal positions (i.e., at 90° increments). This will allow the FAA more flexibility in aiming the cab when the facility is located on a confined plot. The A-E shall provide suitable alternate designs in his shaft/base building interface to provide for these different orientations.

6. MECHANICAL REQUIREMENTS

6.1 General.- The mechanical designs shall be in accordance with the following paragraphs.

6.2 Codes.- The designs shall be in accordance with the following documents.

a. HVAC Design - Heating, Ventilating, Air Conditioning Guide (ASHRAE)
b. Plumbing Design - National Plumbing Code, United States of America Standards Institute, A40.8

6.3 Mechanical reliability requirements

6.3.1 Essential equipment.- Equipment which is necessary for facility operation but can tolerate a short term outage of mechanical services (HVAC) without disruption or serious effect on facility operations.

6.3.2 Non-essential equipment.- Equipment not affected by infrequent extended outages.

6.3.3 Minimum success state.- The operational status of the facility or systems which during equipment failure, maintenance, and testing permits continued and acceptable function capability. This state

for a specific system could be a condition where: (1) Upon failure of a mechanical equipment or component, the facility operational capability is unaffected because a redundant system or component is activated. (2) Upon failure of an equipment or component, the facility operational capability while affected remains acceptable through overlapping functions. (3) Upon failure of an equipment or component, the facility operational capability may be limited, for example, upon loss of heating or cooling, this capability is the time before the room temperature reaches a value which would cause personnel fatigue or equipment malfunction.

6.3.4 Redundancy.- The existence of more than one means for accomplishing a given task, where all means must fail before there is an overall failure to the system.

Parallel redundancy applies to systems where both means are working at the same time to accomplish the task, and either of the systems is capable of handling the job in itself in case of failure of the other system.

Standby redundancy applies to a system where there is an alternative means of accomplishing the task that is switched in by a malfunction sensing device when the primary system fails.

6.3.5 System design considerations.- The ultimate HVAC system should provide for each of the following:

Reliability/redundancy. - Each HVAC load and area requiring HVAC services shall be analyzed to determine how it affects the minimum success state of the ATCT and shall be provided with HVAC system of a reliability sufficient to maintain the minimum success state. This shall be provided through redundancy.

Maintainability.- The mechanical design shall be such that all necessary maintenance work can be performed easily and safely without derogating the system. Components shall be specified so that the mean-time-to-repair (MTTR) is commensurate with an availability approaching unity.

Economy. - The HVAC system shall be designed economically and consistent with reliability and other requirements.

6.4 Heating and cooling zones.- In order to provide for the variable heating and cooling requirements within the contiguous United States, the following outside temperature zones have been standardized.

Winter Climatic Zones	1	2	3	4
Temperature Ranges	+20° & above	+5° to +19°	-10° to +4°	-11° & below

Summer Climatic Zones	A	B	C	D
Temperature Ranges	85° - 96° DB 60° - 68° WB	90° - 100° DB 69° - 72° WB	90° - 100° DB 73° - 76° WB	90° - 100° DB 70° - 80° WB

The heating and air conditioning equipment for all designs shall maintain an inside winter design temperature of 72°F DB and an inside summer design temperature of 75°F DB with 40 to 60 per cent relative humidity maintained at all times.

6.5 HVAC requirements.- For a tabulation of the HVAC requirements and people loads, refer to Table II of this ER. Reference paragraph 7.8 for loads to be used in computing equipment air conditioning loads. All air conditioning equipment shall be automatically controlled to provide winter/summer changeover. All air, outdoor and recirculated, shall be filtered. Air conditioning, ventilating, and heating equipment shall be selected for quiet operation. Vibration dampers, shock mounts for mechanical equipment and piping, duct insulation, acoustical treatment, etc., shall be incorporated in the design to hold noise to an economically acceptable level. The air conditioning equipment serving the equipment rooms (radio and radar), TRACON room, recorder/microwave room, and the cab shall operate on commercial or standby power. The A-E shall design air conditioning (heating and cooling) for the Weather Bureau level.

6.6 Humidity control and ventilation criteria.- Humidity control shall be provided for all systems unless the design analysis determines that it is not warranted for a certain zone or zones. Ventilation systems shall be designed to provide outside air in sufficient quantities to limit room temperature rise to less than 10°F above outside temperature. The A-E shall investigate and provide adequate ventilation based upon the staffing. Emergency ventilation shall consist of a standby forced air ventilating system which shall supply outside filtered air in sufficient volume to prevent the temperature from exceeding a rise of 10°F. The ventilating system for the engine-generator shall be separate from the regular building ventilation system. It operates when the engine-generator operates.

A manually operated exhaust fan shall be provided in each workshop for exhausting cleaning fumes to the outside. Provide an exhaust fan for the kitchen unit in the ready room/snack bar.

6.7 Control cab.- The heating and air conditioning equipment for the control cab shall be located in the junction room (reference 4.6.4). Air conditioning equipment shall not be located within the cab or on the cab roof. If supply grills are in the sill sections, they shall have adjustable vanes or deflectors to direct air away from the glass. Consider the cab stairway as a possible air return system. Outside air shall be induced into the air

conditioning system as required.- The air conditioning system for the cab shall have a redundant system to automatically assume the heat or A/C load in the event the prime unit fails.

6.8 Economics.- The A-E shall design HVAC systems which are the most economical as determined by design requirements, initial cost, operating costs, and maintainability. The A-E shall investigate the feasibility of utilizing electric or radiant heat in some climatic zones. If the investigation concludes that this is feasible and if approved by the Government, the A-E shall incorporate electric or radiant heat into the designs.

6.9 Air and water pollution.- The design shall include air and water pollution controls consistent with the general requirements of Federal and local governments. FAA Order 6900.1, "Abatement and Control of Pollution, Natural Water Resources," shall be consulted.

6.10 Plumbing.- All plumbing shall be in accordance with the "National Plumbing Code."

6.11 Fire protection.- Hand operated fire extinguishers will be installed by the FAA in the control cab, TRACON room, and FAA/TELCO electronic equipment room(s). The FAA will furnish fire extinguisher size. The A-E shall provide location and hangers or cabinets.

6.12 Elevator.- The elevator shall be used for both personnel and freight. The capacity shall be 2500 lbs.; platform dimensions 5' x 6'; door opening 3' 6" wide, 8' floor to ceiling.

6.13 Equipment lift.- The equipment lift shall be a sidewalk type lift. The opening in the cab floor for the lift shall be near the rear of the cab and designed to fit flush with the surrounding floor area when the lift is not in use. The lift entrance in the raised floor shall have a personnel safety device which automatically extends across the open area when the lift is in operation. The equipment lift shall be capable of transporting equipment as large as 36" x 36" x 48" high and weighing 500 lbs.

6.14 Water requirements.- Cooled drinking water shall be provided in the TRACON room, ready room, radar room, radio room, and several other locations throughout the base building. The control cab shall be provided with a water cooler, sink with hot water booster heater below, and an under-counter type refrigerator with minimum capacity of two cubic feet. This unit shall be included in the console line.

6.15 Mechanical control room.- The mechanical control room shall contain monitoring control equipment for the mechanical equipment such as the boiler, chillers or converters, pneumatic or electronic control system, and the emergency engine generators. This monitoring equipment shall provide for visual/audial signals of any mechanical systems malfunctioning. This shall be provided for by the A-E.

7. ELECTRICAL REQUIREMENTS

7.1 General.- The electrical designs shall be in accordance with the following paragraphs.

7.2 Codes and specifications.- The designs shall be in accordance with the following documents.

a. National Electrical Code, Publication No. 70, National Fire Protection Association
b. FAA-C-1217, Electrical Work, Interior
c. FAA-D-2160, Instruction Books, Electrical and Mechanical Equipment
d. FAA-E-2132, Intercom System General Purpose
e. FAA-E-2204, Engine Generator Sets, 5KW to 300KW

7.3 Performance criteria.- The electrical system shall be designed to provide power to various equipment and subsystems of a quality and reliability commensurate with the importance of that component in the total air traffic control system. Maintenance and repair to the electrical distribution system should be possible while de-energized and without causing total system outage or appreciably derogating the normal flow of traffic and other necessary airport activities. This electrical system shall, as far as practical, have a fail-soft characteristic similar to that of the equipment it energizes. Also, short circuits and overloads shall be cleared at the lowest possible level in the system via proper coordination of circuit breakers and/or fuses.

7.4 Distribution system.- The A-E shall design an electrical distribution system which shall commence at the secondary side of the utility company transformer and extend throughout the airport traffic control tower including the control cab. The system shall include the following:

a. building service
b. wiring
c. panelboards
d. ground and lightning protection
e. intercom and paging
f. lighting and receptacles
g. D.C. power system
h. emergency engine generator
i. FAA ducts
j. cable chase
k. security system
l. rechargeable emergency lights for TRACON, tower cab, mechanical/electrical room, radar/radio equipment rooms, shaft, and as required for exit lighting in administrative area or passageways in accordance with FAA Order 6950.9.
m. a tray system interconnecting radio, radar, and TELCO areas with the microwave level and tower cab if required to supplement raised floor cable area.

7.5 Building service.- A 277/480 or 120/208V, 60 Hz, three phase, four wire, secondary underground building service shall be provided at the option of the A-E. The service shall be provided with a separate entrance switch or circuit breaker which shall be located in the mechanical equipment room. The location and size of building load panels for lighting, convenience outlets, and air conditioning shall be determined by the building design.

7.6 Wiring.- Wiring shall be designed in accordance with the National Electrical Code. All wiring shall be run in conduit. Wiring diagrams and graphic symbols shall be in accordance with FAA-STD-002.

7.7 Panelboards.- The A-E's designs shall produce the following panelboards:

a. main distribution panelboard
b. distribution panelboards for building loads; i.e., room lighting, air conditioning, convenience outlets, etc.
c. FAA equipment, panelboards for:

(1) Control cab.- One 20 circuit panelboard, 120/208V, 3 phase, 100 amp mains, 20 amp circuits with one 50 amp circuit to supply service to the rectifier for D.C. circuits (22 circuits see para. 7.11). One 20 circuit panelboard, one pole, 100 amp main, 15 amp circuits.

(2) Radio equipment room.- Two panelboards each with 40 circuits, one pole, 20 amps each, 150 amp main on separate feeders. 120/208V, 3 phase, four wire.

(3) Telephone equipment room.- Sixteen circuit panelboard, 1 pole, 15 amps each, 100 amp main, three phase, four wire.

(4) Recorders.- Eight circuit panelboard, one pole, 20 amps each, 60 amp main.

(5) Radar equipment room.- Provide four each 100 amps, 120/208 V, three phase four wire feeders terminated in a fused disconnect.

(6) Radio and radar workshops.- One panelboard 120/208V, three phase four wire, 100 amp main - provide one-30 amp circuit at 208V in each shop area plus additional circuits for convenience outlets.

(7) Microwave.- Three panelboards each with 16 circuits on separate feeders, single pole breakers, 20 amps, 100 amp main, 120/208 V, three phase, four wire.

(8) TRACON room.- Twenty-four circuit panelboard, 1-pole, 20 amps each, 100 amp main.

d. distribution panelboard for telephone equipment.
e. for the NCTRA Weather Bureau, provide three 50 amp, three-pole breakers in the main breaker panel with space for a fourth three-pole breaker, three phase four wire panels.

All panelboards listed under c, d, and e will have their branch circuits furnished by others. Panelboards shall be accessible for branch circuit installation.

7.8 Estimated power loads.- These are current estimates of electronic equipment loads. Prior to the A-E's design work, the FAA will furnish more accurate loads.

a. tower cab - 10 KVA
b. radio equipment room - 30 KVA
c. recorders and microwave equipment - 50 KVA
d. radar equipment room - 150 KVA
e. TRACON room - 10 KVA
f. Weather Bureau - 5 KVA

7.9 Standby system.- The following panels shall be connected to commercial power with an automatic switchover to standby power in the event of power failure:

a. essential lighting and building power panel(s)
b. essential air conditioning panel(s)
c. tower cab panel(s)
d. recorder/microwave equipment panel(s)
e. Weather Bureau panel(s)
f. radio equipment panel(s)
g. TRACON room panel(s)
h. radar room panel(s)
i. TELCO panel(s)
j. radio/radar workshop(s) panel(s)

The engine generator will be government furnished equipment, including transfer switch, by-pass switch, and control equipment. Refer to Specification FAA-E-2204, "Engine-Generator Sets, 5KW to 30 KW," for engine generator components. The A-E shall determine the load requirement and the FAA will furnish the A-E with standard drawings of equipment available to meet the requirements. Standard layouts of the equipment will be furnished the A-E to detail into the drawings.

7.10 Grounding and lightning protection.- The A-E's designs shall provide for three separate and distinct grounding and lightning protection systems as follows:

a. Lightning protection ground (antenna mounts on the cab roof shall be tied to the lightning protection system ground - reference 4.5.12).
b. FAA electronic equipment.
c. Electrical power system.

7.11 D.C. cab power system.- Certain electrical equipment used by the FAA requires a nominal 12 volt D.C. electrical power supply. The A-E's design shall include this D.C. system in compliance with the following major requirements:

a. A 22 circuit panelboard to permit distribution to individual equipment in the tower cab. Maximum load on any circuit will be approximately five amps. Total equipment load will be approximately 50 amps.

b. Battery system capable of sustaining operation of the equipment for a period of four hours after loss of commercial power. Refer to paragraph 4.6.4.

c. System steady-state voltage at the equipment shall remain within a 10 to 14 volt envelope, whether being energized by commercial power or from batteries alone or during the transition period from commercial power to batteries.

d. AC to DC rectifier with sufficient capacity to supply power to the above equipment and recharge the batteries within 12 hours following a four-hour operation of the batteries. Maximum DC system output ripple to equipment shall not exceed 100 millivolts peak when energized by commercial power and without batteries. The AC to DC rectifier shall be solid state and of the type accepted by the telephone and microwave industry.

e. Distribution system complete, including the AC power to rectifier, the rectifier, batteries, cabling or bus, up to and including the 22 circuit panelboard.

f. The rectifier and battery design and specification shall be separate from other designs and specifications to permit the Government to purchase these items individually if so desired.

7.12 Lighting and receptacles.- Lighting and receptacles shall be designed in accordance with the Illuminating Engineering Society's Handbook and National Electrical Code criteria and requirements. The following rooms shall have their lighting on the essential power circuit:

a. Cab
b. Microwave level
c. Weather Bureau operations room
d. Radio equipment room
e. Radar equipment room
f. Recorder equipment room
g. Telco equipment room
h. TRACON operations room
i. Engine-generator room
j. Mechanical equipment room
k. Mechanical control room

7.13 Intercom system and paging.- The A-E's designs shall provide an intercom system as follows:

a.

Office	Masters	To
AT Section Chief		AT Ass. Chief, AT Watch Supervisor, AT Clerk-Steno, AF Administrative area (AF Chief, AF Ass. Chief, AF Watch, and AF Clerk-Steno)
AT Ass. Chief		AT Chief, AT Watch, AT Clerk-Steno, and AF Administrative area
AT Watch		AT Chief, AT Ass. Chief, AT Clerk-Steno, AF Watch, and AF Administrative area
AT Clerk-Steno		AT Chief, Ass. Chief, Watch, and AF Administrative area
AF Section Chief		AF Ass. Chief, AF Watch Supervisor, AF Clerk-Steno, AF Administrative area. (AT Chief, AT Ass. Chief, AT Watch, and AT Clerk-Steno)
AF Ass. Chief		AF Chief, AF Watch, AF Clerk-Steno, and AT Administrative area
AF Watch		AF Chief, AF Ass. Chief, AF Clerk-Steno, AT Watch, and AT Administrative area
AF Clerk-Steno		AF Chief, AF Ass. Chief, AF Watch, and AT Administrative area

b.

Office	Master	To
AF Admin. Area		Facility Manager office and Proficiency and Development office
	2 Way Slaves	
AF Watch		All shops, all other AF offices, all major equipment rooms
Facility Manager		Same as above
Proficiency and Development officer		Same as above

c.

Office	Master	To
AT Admin. Area		Cab, TRACON
	2 Way Slaves	
AT Chief		AT Training officer, Data System officer, Planning officer
AT Ass. Chief		Same as above
AT Clerk-Steno		Same as above
Cab		Equipment rooms, ready room, Security points (main entrance, door to cab)
TRACON		Same as above

7.14 Other electrical items

a. Ionization fire and smoke detection system shall be provided throughout the structure with detection centers located in the tower cab and in the AF chief's office.

b. Electronic door locks with release control located in tower cab shall be installed at main building entrance and at the cab stairway door in junction room. Annunciators connecting these points to the cab shall be provided to request entrance. Also, a push button combination lock system shall be provided to open these doors when the proper number code is entered. These security locks shall operate independnet of each other.

c. Provide variable intensity recessed lighting fixtures in control cab as required to complement those in consoles.

d. Provide radio interference suppressors for fluorescent fixture ballasts located in the TRACON, radio and radar rooms, and the radio and radar shops.

8. NATIONAL STANDARD DESIGNS

The national standard designs shall comply with the following paragraphs, and with sections 4, 5, 6, and 7 except those paragraphs that exclusively apply to the NCTRA design; i.e., 4.1, 4.2, 4.5.1, 4.6.2, 4.7, and 7.6e.

8.1 Codes.- The national standard design shall be in compliance with Volume 1, Uniform Building Code, current edition. The A-E shall recognize and consider when developing the national standard designs that although they shall be in compliance with cited code, the site adapted designs shall be required to comply with local building codes.

8.2 Appearance.- In general, the exterior of the national standard design shall be such that the materials/colors may be readily site adapted to be aesthetically compatible with the other airport structures. Optional exterior materials shall be detailed on the national standards as site adaption alternates. All painting shall be in accordance with FAA-STD-003.

8.3 Tower shaft.- The A-E shall develop 3 heights of tower shafts (180', 150', and 120') as measured from ground level to the cab floor. The shape of the shaft shall be the same as selected for the NCTRA design.

8.3.1 Modification of 180' NCTRA shaft.- The A-E shall utilize the 180' shaft developed for NCTRA as one of the national standard design towers by removing the Weather Bureau space.

8.4 Cab.- The A-E shall design a national standard cab to meet the requirements of the following subparagraphsand paragraph 4.5 excluding 4.5.1. Also, the A-E shall modify the Type C-2 cab drawings as outlined below.

8.4.1 Shape.- The national standard cab shall be a modified octagon in which the four diagonal corners are one-half the length of the four long sides. The diagonal corners shall be at a 45° angle to the long sides. The cab shall have a minimum floor area of 400 square feet exclusive of the area taken up by the stairwell. Every effort shall be made to reduce glare and reflections on the cab glass and corners. A study is presently underway regarding the reduction of glare, reflection, and heat transfer for ATCT cab glass. Progress reports of this study will be furnished to the A-E as the project develops.

The current agency standard Type C-2 (Cab C-1 Sheets 1-16 and and C-2 Sheets 20-24) is a five-sided cab of suitable size for high activity operations. The A-E shall provide connection alternates on top of the standard shafts to receive this cab. An alternate junction room layout shall also be provided to accommodate this cab with centrally located staircase. In addition, the A-E shall provide alternate mechanical/electrical/plumbing details as required on the C-2 drawings or separate drawings to show changes required when using the cab on these new shafts.

8.4.2 Climatic zones.- HVAC equipment for the zones specified in paragraph 6.4 shall be detailed into the national standard designs. A tabular listing is preferred.

8.4.3 Structural.- In addition to the requirements of section 5, the cab roof shall be designed to withstand the following loads due to airport surface detection equipment (ASDE) mounted on the roof.

a. Dead load:

(1)	Radome	1600 lbs.
(2)	Radar antenna pedestal and motor	1700 lbs.
(3)	Radar antenna reflector and support	450 lbs.

b. Live load:

(1)	Radome	30 psf
(2)	Radome platform	30 psf

c. Lateral loads:

The ASDE radome and platform housing shall withstand a wind of 130 mph.

Refer to Cab C-2A Sheets 30-33 for ASDE connection details.

8.5 Site adaption handbook.- The A-E shall prepare a site adaption handbook for the standard elements of the major activity level airport traffic control tower design. The format of this handbook will be furnished by the Contracting Officer. The purpose of the handbook will be to convey to others, particularly those site adapting the designs, complete information on its development and the changes required for its site adaption. The handbook shall contain the following:

a. design assumptions and parameters
b. required changes to drawings and specifications for site adaption
c. construction time analysis
d. all design calculations

9. STANDARD WORKING DRAWINGS

9.1 Sets required.- The A-E shall submit separate sets of drawings for each of the following:

Set 1 - 180' NCTRA shaft and Weather Bureau
Set 2 - 11-sided cab
Set 3 - base building
Set 4 - 180' standard shaft
Set 5 - 150' standard shaft
Set 6 - 120' standard shaft
Set 7 - octagonal cab
Set 8 - C-2 cab (revisions)

9.2 Architectural/structural/mechanical/electrical drawings.- All sets shall contain complete requirements (architectural, structural, mechanical, electrical) to construct the designs. Sets 1, 4, 5, and 6 shall show the control cab outline in sufficient detail so that all

connections and other construction requirements are clear and understandable. Set 3 shall show the shaft in sufficient detail in a similar manner. Sets 2 and 7 shall contain all the cab details and any other required information pertaining to the interface of cab/shaft which is not shown on Sets 1, 4, 5, and 6. The C-2 cab drawings are not listed above but shall be revised by the A-E as required for use on the standard shaft. A set of vellum drawings of the C-2 cab and specification, will be furnished to the A-E for his revision. The shaft shall be capable of receiving all cabs developed under this ER, and being oriented as specified in 5.2. These alternates shall be clearly detailed and described in the A-E's specification and on the drawings.

9.3 Drawing requirements.- All FAA drawings shall be made on clear-print paper no. 1000 H or equal with the FAA title block in the lower right hand corner. Provide 1/2" border lines on the top, bottom, and left hand side. The drawings shall be made on "E" size sheets (34" x 44"). Sample title and index sheets will be furnished. Drawings shall be prepared in accordance with FAA Standard, FAA-STD-002. These drawings will be reduced to one-half size by the FAA in the future. For this reason, the A-E shall take effort to assure that all drawings are clear and legible. The details and printing shall be of the size required for microfilming on 35 mm film. The minimum letter height for a 22" x 34" sheet will be 5/32" and .05" spacing between letters; for 34" x 44" the letter height shall be 3/16" and 1/16" spacing between letters. All letters shall be vertical capital letters.

10. STANDARD CONSTRUCTION SPECIFICATIONS

Standard construction specifications for the designs shall be prepared by the A-E in accordance with FAA-STD-005b, "Preparation of Specification Documents." The drawings and specifications developed by the A-E for the NCTRA design shall be complete to the degree that they can be used by the Government without modification as technical documents for inclusion in a Government contract for construction.

11. MECHANICAL AND ELECTRICAL SYSTEMS REFERENCE HANDBOOK

A handbook covering the description and operation of the mechanical and electrical systems of the NCTRA ATCT shall be prepared by the A-E. Also, separate handbooks shall be prepared for each of the designs of the national standard designs. The purpose of the handbook is to provide a total systems overview of its operation and the interface of each mechanical and electrical system. This shall be provided through the use of schematics, one line diagrams, and written descriptions. The handbook shall contain catalog cuts, technical information, and any other data that has been detailed in the specifications or on the drawings. This information is to be used as a basis of comparison for any equipment being substituted by the contractor. The handbook shall be prepared in accordance with Specification FAA-D-2160.

12. DESIGN DATA HANDBOOKS

The A-E shall prepare a design data summary handbook for the NCTRA design. The format for this will be furnished by the FAA. The purpose of the handbook is to convey complete information on the design development. The handbook shall contain the following.

a. design assumptions and parameters
b. all design calculations

13. STANDARD ENGINEERS COST ESTIMATES

The A-E shall prepare cost estimates for the construction of the NCTRA design and all the standard designs. The estimates shall be in accordance with FAA Order 6010.4, "Engineering Cost Estimates for Construction of FAA Facilities." Standard FAA estimating forms will be furnished the A-E.

14. COST CONTROL ANALYSIS

14.1 Cost comparison study.- The A-E shall conduct a cost comparison study to determine the optimum total system design for both the standard shafts and cabs, and the NCTRA ATCT. The analysis shall include, but not be limited, to such items as architectural and structural materials, adaptability of such materials to different sites, mechanical-electrical systems, and operational costs.

14.2 Construction cost control.- During all phase of the design program, the A-E shall maintain a continuing construction cost analysis of the NCTRA design to assure that the construction cost for April 1971 does not exceed $2,000,000. Should any analysis indicate that the stipulated construction cost is being exceeded as a result of adhering to the design requirements specified herein and suitable design alternates are not obtainable, the A-E shall immediately notify the Contracting Officer. As part of the notification, the A-E shall state which requirements are causing excessive costs and what corrective action is recommended.

15. CONSTRUCTION SCHEDULE

The A-E shall prepare a network schedule analysis showing the order in which a construction contractor could reasonably be expected to accomplish the construction work within a twelve month period at NCTRA including procurement of materials, availability of support equipment, plant or facilities, and specific requirement dates for delivery of Government furnished equipment. The network shall be CPM (Critcial Path Method) type in accordance with the Federal Procurement Manual Part 2-18.8.

16. CONSTRUCTABILITY ANALYSIS

The A-E in association with experienced construction personnel shall study the construction schedule, drawings and specification, and cost estimates to determine unusual construction restraints. An informal document which lists categories and gives the impact of these restraints on the NCTRA design shall be prepared. This document shall include, but not be limited to, climatic conditions, material availability, materials delivery time, non-standard items, expensive operations, special labor and cost, unusual construction equipment, and other unique conditions which might increase costs, restrict construction, or delay the construction schedule.

17. QUALITY ASSURANCE PROVISIONS

The A-E or his authorized representative shall sign the original tracings of all drawings and the first page of all specifications, estimates, or similar documents under the A-E's printed name and over the affixed replica of his professional seal or his registration certification number including the state or jurisdiction of issue.

18. PREPARATION FOR DELIVERY

The A-E shall be responsible for packaging, marking, and shipping all documents required by this engineering requirement to 800 Independence Avenue, SW., Washington, D. C. 20590.

BASE BUILDING ROOM OR FUNCTION	FLOOR SPACE SQ. FT.	SPACE RELATIONSHIPS AND REQUIREMENTS
TRACON	2500	- Locate between radio equip. rm. & radar equip. rm. - Expansion capability - Proximate to elevator
Radar/Computer Equipment	3500	- Locate adjacent to TRACON - Expansion capability - Proximate to cable chase
Radar Shop Radar Storage	175 150	- Colocate adjacent to Radar/Computer Equip. rm.
Radio Equip.	2500	- Locate adjacent to TRACON - Expansion capability - Proximate to cable chase
Radio Shop Radio Storage	175 150	- Colocate adjacent to Radio equip. room
TELCO	1000	- Outside wall - Proximate to cable chase and TRACON room
Engine-generator	1000	- Locate to have two exterior walls - corner
Elect. Service Vault	350	- Locate adjacent to E/G room
Cable Entrance Pit	200	- Locate adjacent to elect. service vault - Proximate to radio and radar equip. rooms
Mechanical Equip.	As Req'd	- Proximate to elect. service vault
Mechanical Control Rm.	150	- Colocate with Mech. equip. rm.
Grounds Maintenance Storage	150	- Exterior wall/door

TABLE I - SPACE & ROOM REQUIREMENTS

Ready Room/Snack Bar	450	- Proximate to TRACON and elevator
Recorder Equip. Room	150	- Proximate to control cab
Locker Room	300	- Proximate to TRACON Room - In traffic flow of personnel going on and off duty
AT Chief Office	200	
AT Ass't Chief Office	150	- Adjacent to AT Chief Office
AT Sec'y Office/Receptionist	150	- Adjacent to AT Chief Office
AT Training Chief and Assistant's Office	200	- Proximate to AT Chief Office
Clerk-Steno	100	- Between the AT Training Chief Office and AT Data Systems Officer Office
AT Data Systems Officer and Assistants Office	200	- Proximate to AT Chief Office
AT Operations Officer and Assistants Office	200	- Proximate to AT Chief Office
Clerk-Steno	100	- Between AT Operations Office and AT Supv. Planning Officer Office
AT Supv. Planning Officer, Asst. & Cartographer Office	300	- Proximate to AT Chief Office
AT Training/Conference Room	400	- Proximate to TRACON, office areas, and elevator
AT Storage	200	- Proximate to AT Chief Office

AF Chief Office	200	
AF Ass't Chief Office	150	- Adjacent to AF Chief Office
AF Sec'y Office/Receptionist	150	- Adjacent to AF Chief Office
AF Material Spec. Office	150	- Proximate to AF Chief Office
AF Training Officer Office	150	- Proximate to AF Chief Office
AF Watch Supervisor/Unit Chief with Clerk	200	- Proximate to TRACON room and elevator
AF Technicians in Depth	320	- Proximate to AF Chief Office
AF Facility Manager	200	- Proximate to Electrical/Mechanical Shop
Electrical/Mechanical Shop	400	- Proximate to Engine-Generator Room and Mechanical/Electrical Room
AF Training/Conference Room	400	- Adjacent to AF Training Officer's Office
AF Storage	200	- Proximate to AF Material Spec. Office

	H	AC	EV	V	OI	PL
Control cab	X	X	X	X	X	15
Junction room	X	X	-	X	-	2
Microwave level	X	X	X	X	-	2
Weather Bureau level	X	X	-	X	-	8
TRACON room	X	X	X	X	-	30
Radar/computer equipment room	X	X	X	X	-	6
Radar shop	X	X	-	X	-	4
Radar storage	X	-	-	X	-	-
Radio equipment room	X	X	X	X	-	4
Radio shop	X	X	-	X	-	4
Radio storage	X	-	-	X	-	-
Telco room	X	X	-	X	-	4
Engine-generator room	X	-	-	X	-	-
Electric service vault	X	-	-	X	-	-
Cable entrance pit	X	-	-	X	-	-
Mechanical equipment room	X	X	-	X	-	4
Mechanical control room	X	X	-	X	-	2
Grounds maintenance storage	X	-	-	X	-	-
Ready room/snack bar	X	X	-	X	-	30
Training/Conference room	X	X	-	X	-	25
Locker room	X	X	-	X	-	30
Restroom(s)	X	X	-	X	-	8
Training officer	X	X	-	X	-	8
AT & AF Chief Office	X	X	-	X	-	10
Average of all other offices	X	X	-	X	-	4
Storage	X	-	-	X	-	-

H - Heating
AC - Air conditioning
V - Ventilation
EV - Emergency ventilation
S - Design to determine requirement
X - Design requirement
OI - Air conditioning equipment operates independently of any other building load
PL - Maximum personnel load for HVAC considerations

TABLE II

FAA-STD-017

BY_____DATE_____ SUBJECT FAA NATIONAL ~T.U. SHEET NO._____OF_____
CHKD. BY_____DATE_____ JOB NO._____

DESIGN CRITERIA

WIND LOADS	180 FT. TOWER	30 PSF WIND PRESSURE AREA
	150 FT. TOWER 120 FT. TOWER	40 PSF WIND PRESSURE AREA
CAB L.L.	ROOF	50 PSF 60 PSF
	FLOOR	80PSF + 500# PT. LD.
CAB. W.L.		60 PSF ON PROJ. FACE 84 PSF SUCTION (INDIVIDUAL MEMBER)
EQUIPMENT ROOMS L.L.		150 PSI

FAA-STD-017

BY_____DATE_____ SUBJECT FAA. NAT'L. STD. SHEET NO._____OF_____
CHKD. BY_____DATE_____ JOB NO._____

NATIONAL STANDARD WIND ANALYSIS

180'	TOWER	30 P.S.F. WIND PRESSURE @ 30'
150'	TOWER	40 PSF. WIND PRESSURE @ 30'
120'	TOWER	40 P.S.F. WIND PRESSURE @ 30'

WIND LOADING INCLUDES PROVISIONS FOR AN 80' DIAM. WEATHER STATION STRUCTURE: WEATHER STATION LOCATED AT 90' LEVEL FOR THE 180' AND 150' TOWER. WEATHER STATION LOCATED AT 60' LEVEL FOR THE 120' TOWER.

WIND MOMENTS <BASE>		WIND SHEARS <BASE>
95,360,000 "# 73,960,000 "#	180' TOWER	70,310 # 54,530 #
88,200,000 "# 68,400,000 "#	150' TOWER	74,310 # 57,630 #
55,800,000 "# 43,280,000 "#	120' TOWER	56,790 # 44,050

f'_c = 5,000 PSI (CONCRETE)
f_y = 60,000 PSI (REINF. STEEL)

FAA-STD-017

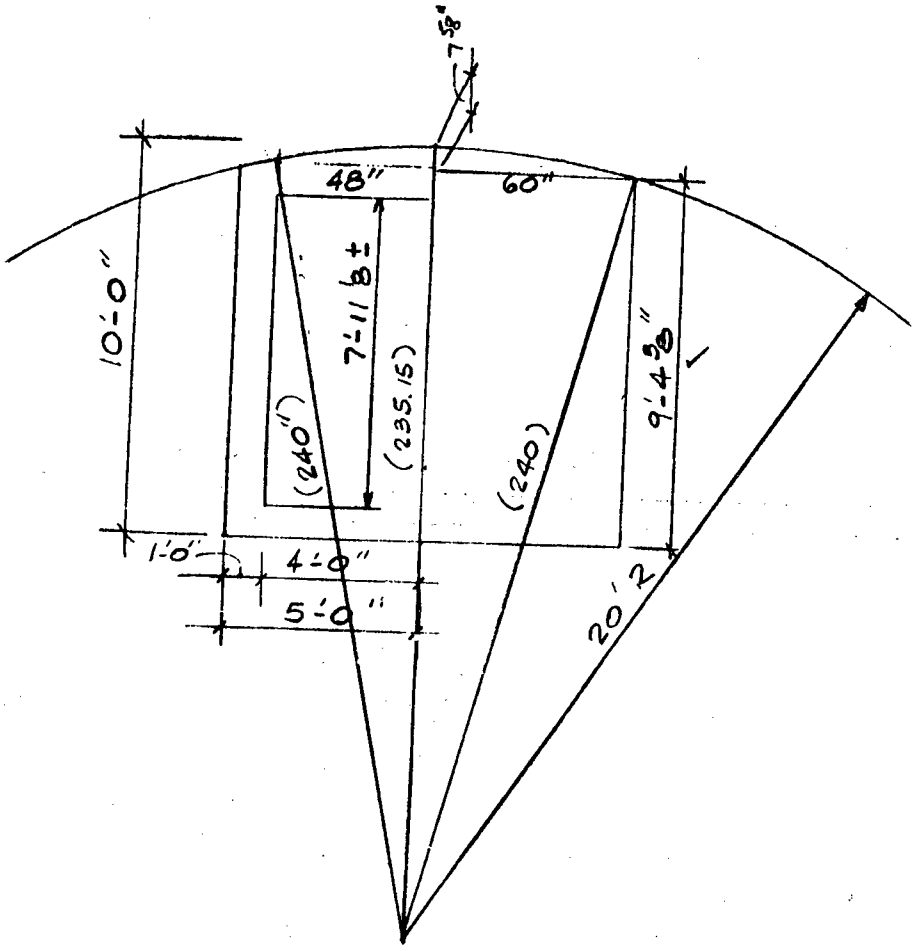
BK DATE

CKD. BY DATE

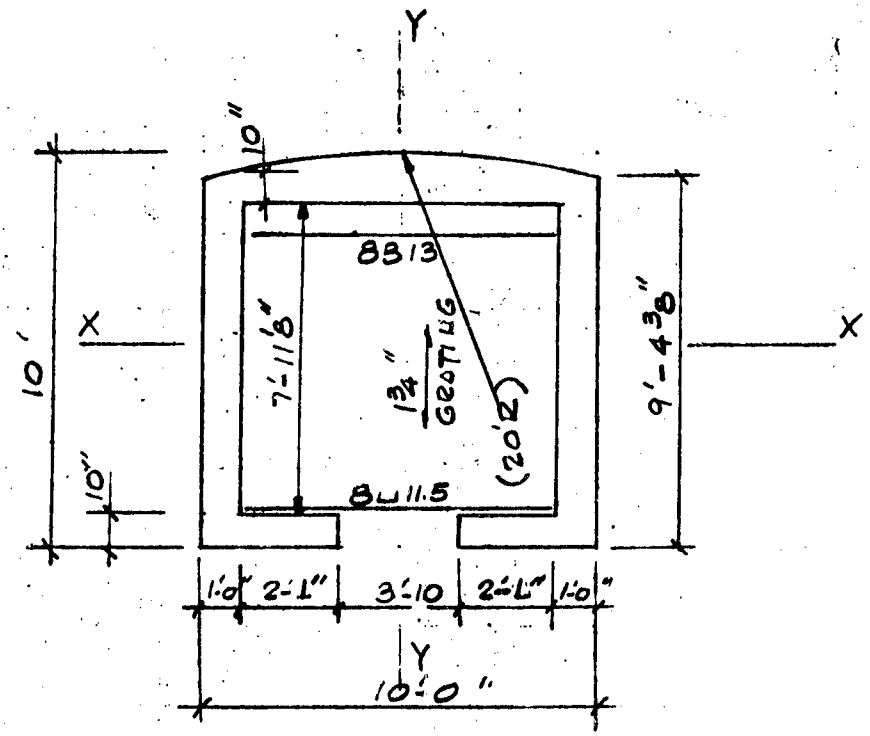
SUBJECT FAA TOWERS

SHEET NO. OF

JOB NO.



BY BK DATE ____ SUBJECT FAA TOWERS SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____



$$\bar{X} = \frac{(2 \times 12 \times 112.37 \times 56.2)}{2697} + \frac{(96 \times 12 \times 111.15)}{1152} + \frac{(2 \times 10 \times 25 \times 5)}{500}$$

$$= 282,110 / 4349 = 64.87'' = 5.41'$$

$$\bar{Y} = 60.0'' = 5'-0''$$

FAA-STD-017

BY BK DATE ____ SUBJECT FAA TOWER SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

I_{xx} =

$12 \times \frac{(112.37)^3}{12} \times 2 = 2,837,796$

$12 \times 112.37 \times (8.63)^2 \times 2 = 203,189$

$25 \times \frac{(10)^3}{12} \times 2 = 4,167$

$250 \times (59.57)^2 \times 2 = 1,792,208$

$96 \times \frac{(12)^3}{12} = 13,824$

$96 \times 12 \times (46.28)^2 = 2,467,398$

$7,318,582 \text{ in}^4$

I_{yy} =

$112.37 \times \frac{(12)^3}{12} \times 2 = 32,363$

$12 \times 112.37 \times (54)^2 \times 2 = 7,864,102$

$10 \times \frac{(25)^3}{12} \times 2 = 26,041$

$10 \times 25 \times (35.5)^2 \times 2 = 630,125$

$12 \times (96)^3/12 = 884,736$

$9,437,367 \text{ in}^4$

I_{TOTAL}

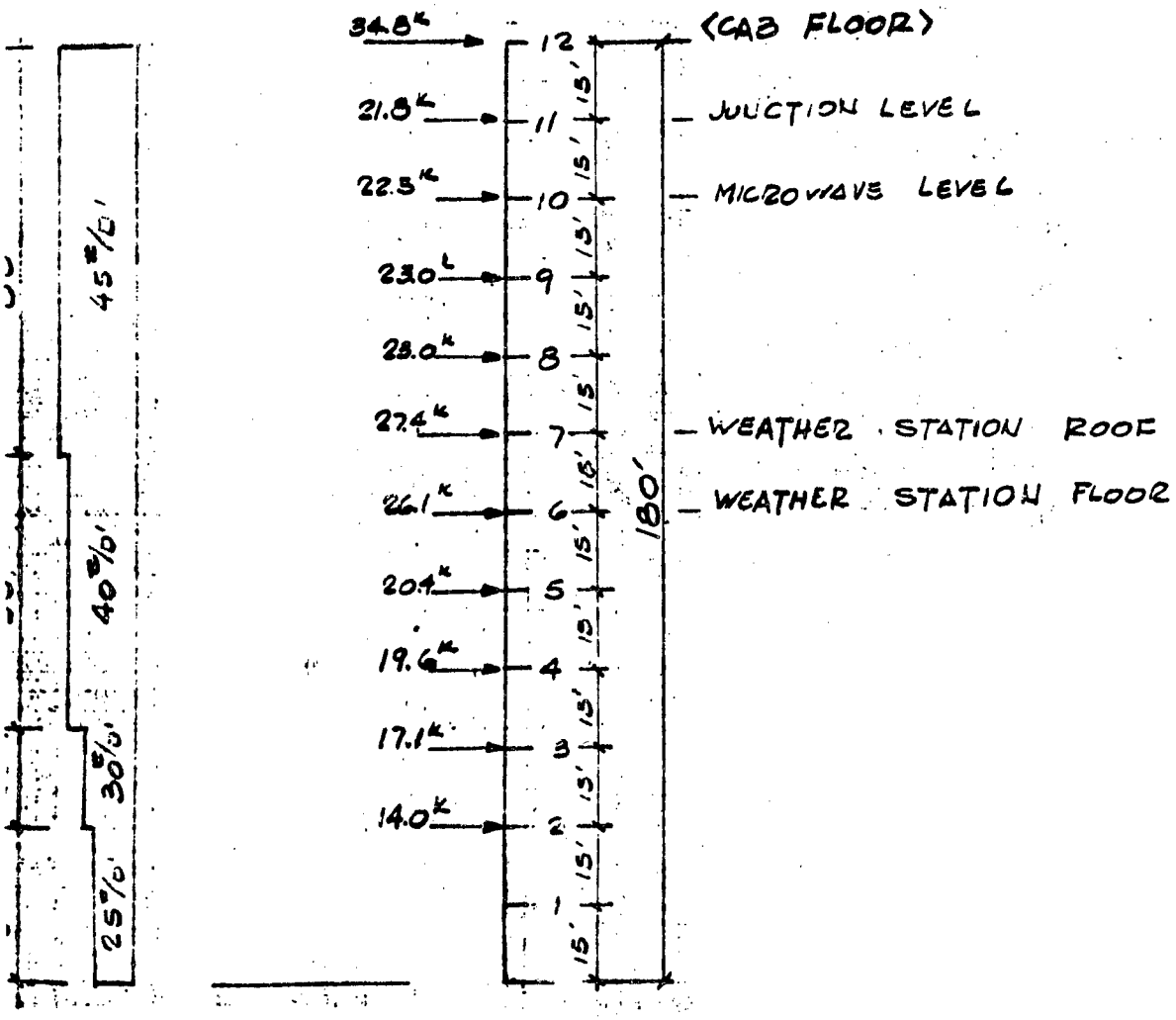
$7,318,582 \text{ in}^4$	.218	22%
$7,318,582$	.218	✓
$9,437,367$	.282	28%
$9,437,367$	.282	✓
$33,511,898 \text{ in}^4$	1.000	

FAA-STD-017

BY BK DATE ____ SUBJECT F.A.A. TOWERS SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ 180' TOWER JOB NO. ____

30 PSF WIND PRESSURE AREA



BY_____DATE_____ SUBJECT_____ SHEET NO._____OF_____
CHKD. BY_____DATE_____ JOB NO._____

ELEVATION (FT)	WIDTH (FT)	FACTOR	W_P PSF	W_P K	JOINT LOAD C	REMARKS
210	16	.6	45	6.5		ASDE DOME
195						
180	32 AV	.8	45	17.3		CAB
					34.8K	
165	40	.8	45	21.6	21.8K	JUNCTION
150	54 AV.	.6	45	22.0	22.6K	MICROWAVE
135	34	1.0	45	23.0		
					23.0	
120	34	1.0	45	23.0		
					23.0	
105	34	1.0	45	23.0		
					27.4	
90	84 AV	.6	42 AV.	31.8		WEATHER STAT.
					26.1	
75	34	1.0	40	20.4		
					20.4	
60	34	1.0	40	20.4		
					19.6	
45	34	1.0	37 AV	18.8		
					17.1	
30	34	1.0	30	15.3		
					14.0	
15	34	1.0	25	12.7		

BY BK DATE ____ SUBJECT FAA TOWERS SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

EM @ 1ST FLOOR

$14^K \times 30'$	=	420
17.1×45	=	770
19.6×60	=	1176
20.4×75	=	1530
26.1×90	=	2349
27.4×105	=	2877
23.0×120	=	2760
23.0×135	=	3105
22.5×150	=	3375
21.8×165	=	3597
34.8×180	=	6264
		$28,223^{1K}$

$M_1 = .22 \times 28,223 = 6209^{1K}$ $74,508^{11K}$

$M_2 = .28 \times 28,223 = 7902^{1K}$ $94,824^{11K}$

(1) $Mc/I = \frac{74,508 \times 1000}{7,318,582} \times 64.87'' = 660$ PSI

(2) $Mc/I = \frac{74,508 \times 1000}{7,318,582} \times 52.28'' = 532$ PSI

(3) $Mc/I = \frac{94,824 \times 1000}{9,437,367} \times 60.0'' = 603$ PSI

* PRELIM. FIGURES VARY SLIGHTLY FROM COMPUTER PRINTOUT

FAA TOWER - NATIONAL STANDARD - WIND ANALYSIS
GUNNIN 7-8-70 180-0 TOWER

NOTE - 4000 PSI CONCRETE ASSUMED FOR COMPUTATION OF E

STORY					
1	HEIGHT	0.1800E 03			
1	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
1	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
1	HOR SHR	0.2496E 06			
2	HEIGHT	0.1800E 03			
2	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
2	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
2	HOR SHR	0.2496E 06			
3	HEIGHT	0.1800E 03			
3	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
3	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
3	HOR SHR	0.2356E 06			
4	HEIGHT	0.1800E 03			
4	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
4	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
4	HOR SHR	0.2186E 06			
5	HEIGHT	0.1800E 03			
5	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
5	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
5	HOR SHR	0.1989E 06			
6	HEIGHT	0.1800E 03			
6	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
6	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
6	HOR SHR	0.1786E 06			
7	HEIGHT	0.1800E 03			
7	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
7	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
7	HOR SHR	0.1525E 06			
8	HEIGHT	0.1800E 03			
8	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
8	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
8	HOR SHR	0.1251E 06			
9	HEIGHT	0.1800E 03			
9	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
9	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
9	HOR SHR	0.1020E 06			
10	HEIGHT	0.1800E 03			
10	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
10	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
10	HOR SHR	0.7910E 05			
11	HEIGHT	0.1800E 03			
11	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
11	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
11	HOR SHR	0.5660E 05			
12	HEIGHT	0.1800E 03			
12	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
12	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
12	HOR SHR	0.3480E 05			

FIXITY OF COLUMNS AT THE BASE
0.1000E 01 0.1000E 01 0.1000E 01 0.1000E 01

DEFLECTIONS AND ROTATIONS FOR LOAD CASE 1

STORY	DEFLECTION	ROTATIONS			
1	-0.4293E-01	-0.4660E-03	-0.4660E-03	-0.4660E-03	-0.4660E-03
2	-0.1638E 00	-0.8658E-03	-0.8658E-03	-0.8658E-03	-0.8658E-03
3	-0.3507E 00	-0.1201E-02	-0.1201E-02	-0.1201E-02	-0.1201E-02
4	-0.5926E 00	-0.1476E-02	-0.1476E-02	-0.1476E-02	-0.1476E-02
5	-0.8789E 00	-0.1696E-02	-0.1696E-02	-0.1696E-02	-0.1696E-02
6	-0.1200E 01	-0.1865E-02	-0.1865E-02	-0.1865E-02	-0.1865E-02
7	-0.1548E 01	-0.1991E-02	-0.1991E-02	-0.1991E-02	-0.1991E-02
8	-0.1915E 01	-0.2080E-02	-0.2080E-02	-0.2080E-02	-0.2080E-02
9	-0.2295E 01	-0.2139E-02	-0.2139E-02	-0.2139E-02	-0.2139E-02
10	-0.2683E 01	-0.2174E-02	-0.2174E-02	-0.2174E-02	-0.2174E-02
11	-0.3076E 01	-0.2190E-02	-0.2190E-02	-0.2190E-02	-0.2190E-02
12	-0.3471E 01	-0.2195E-02	-0.2195E-02	-0.2195E-02	-0.2195E-02

δ = 3.5"

LOAD CASE 1

STORY					
	MOMENTS				
1	COL TOP	-0.6414E 08	-0.6414E 08	-0.8271E 08	-0.8271E 08
1	COL BOT	0.7396E 08	0.7396E 08	0.9536E 08	0.9536E 08
1	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
1	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
1	COLUMNS	0.5453E 05	0.5453E 05	0.7031E 05	0.7031E 05
1	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
1	P*DELTA	0.0000E 00			
	MOMENTS				
2	COL TOP	-0.5433E 08	-0.5433E 08	-0.7005E 08	-0.7005E 08
2	COL BOT	0.6414E 08	0.6414E 08	0.8271E 08	0.8271E 08
2	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
2	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
2	COLUMNS	0.5453E 05	0.5453E 05	0.7031E 05	0.7031E 05
2	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
2	P*DELTA	0.0000E 00			
	MOMENTS				
3	COL TOP	-0.4506E 08	-0.4506E 08	-0.5810E 08	-0.5810E 08
3	COL BOT	0.5433E 08	0.5433E 08	0.7005E 08	0.7005E 08
3	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
3	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
3	COLUMNS	0.5147E 05	0.5147E 05	0.6637E 05	0.6637E 05
3	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
3	P*DELTA	0.0000E 00			
	MOMENTS				
4	COL TOP	-0.3647E 08	-0.3647E 08	-0.4702E 08	-0.4702E 08
4	COL BOT	0.4506E 08	0.4506E 08	0.5810E 08	0.5810E 08
4	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
4	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
4	COLUMNS	0.4774E 05	0.4774E 05	0.6155E 05	0.6155E 05
4	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
4	P*DELTA	0.0000E 00			
	MOMENTS				
5	COL TOP	-0.2865E 08	-0.2865E 08	-0.3694E 08	-0.3694E 08
5	COL BOT	0.3647E 08	0.3647E 08	0.4702E 08	0.4702E 08
5	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
5	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
5	COLUMNS	0.4346E 05	0.4346E 05	0.5603E 05	0.5603E 05
5	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
5	P*DELTA	0.0000E 00			
	MOMENTS				
6	COL TOP	-0.2162E 08	-0.2162E 08	-0.2788E 08	-0.2788E 08
6	COL BOT	0.2865E 08	0.2865E 08	0.3694E 08	0.3694E 08
6	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
6	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
6	COLUMNS	0.3900E 05	0.3900E 05	0.5029E 05	0.5029E 05

100'
115'
130'
145'
160'
175'

6 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00		
6 P*DELTA	0.0000E 00				
MOMENTS					
7 COL TOP	-0.1563E 08	-0.1563E 08	-0.2015E 08	-0.2015E 08	
7 COL BOT	0.2162E 08	0.2162E 08	0.2788E 08	0.2788E 08	190'
7 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00		
7 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00		
SHEARS					
7 COLUMNS	0.3330E 05	0.3330E 05	0.4294E 05	0.4294E 05	
7 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00		
7 P*DELTA	0.0000E 00				
MOMENTS					
8 COL TOP	-0.1071E 08	-0.1071E 08	-0.1381E 08	-0.1381E 08	
8 COL BOT	0.1563E 08	0.1563E 08	0.2015E 08	0.2015E 08	205'
8 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00		
8 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00		
SHEARS					
8 COLUMNS	0.2732E 05	0.2732E 05	0.3522E 05	0.3522E 05	
8 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00		
8 P*DELTA	0.0000E 00				
MOMENTS					
9 COL TOP	-0.6702E 07	-0.6702E 07	-0.8642E 07	-0.8642E 07	
9 COL BOT	0.1071E 08	0.1071E 08	0.1381E 08	0.1381E 08	220'
9 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00		
9 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00		
SHEARS					
9 COLUMNS	0.2229E 05	0.2229E 05	0.2875E 05	0.2875E 05	
9 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00		
9 P*DELTA	0.0000E 00				
MOMENTS					
10 COL TOP	-0.3593E 07	-0.3593E 07	-0.4632E 07	-0.4632E 07	
10 COL BOT	0.6702E 07	0.6702E 07	0.8642E 07	0.8642E 07	235'
10 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00		
10 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00		
SHEARS					
10 COLUMNS	0.1727E 05	0.1727E 05	0.2227E 05	0.2227E 05	
10 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00		
10 P*DELTA	0.0000E 00				
MOMENTS					
11 COL TOP	-0.1368E 07	-0.1368E 07	-0.1763E 07	-0.1763E 07	
11 COL BOT	0.3593E 07	0.3593E 07	0.4632E 07	0.4632E 07	250
11 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00		
11 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00		
SHEARS					
11 COLUMNS	0.1236E 05	0.1236E 05	0.1593E 05	0.1593E 05	
11 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00		
11 P*DELTA	0.0000E 00				
MOMENTS					
12 COL TOP	0.0000E 00	-0.1265E 02	-0.3626E 01	0.1813E 01	
12 COL BOT	0.1368E 07	0.1368E 07	0.1763E 07	0.1763E 07	265'
12 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00		
12 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00		
SHEARS					165
12 COLUMNS	0.7600E 04	0.7600E 04	0.9799E 04	0.9799E 04	

```
12 BEAMS     0.0000E 00   0.0000E 00   0.0000E 00
12 P*DELTA   0.0000E 00
```

EQUILIBRIUM CHECK - UNBALANCED FORCES

LOAD CASE 1

STORY	SHEAR	MOMENTS			
1	0.2099E-01	0.5625E 00	0.5625E 00	-0.1875E 00	-0.6250E 00
2	-0.6103E-02	-0.3750E 00	0.3750E 00	-0.5000E 00	0.1000E 01
3	-0.5529E-01	0.7187E 00	0.1437E 01	-0.9062E 00	0.9062E 00
4	-0.1025E-01	0.8468E 01	0.4937E 01	0.7250E 01	0.5468E 01
5	0.2263E 00	0.2093E 01	-0.1406E 01	-0.6375E 01	0.3125E-01
6	-0.2368E 00	-0.2812E 01	-0.5625E 01	-0.9078E 01	0.3656E 01
7	0.3537E 00	0.2812E 01	0.9843E 01	-0.7250E 01	-0.1995E 02
8	-0.4334E 00	-0.2671E 02	-0.1828E 02	-0.2175E 02	-0.1994E 02
9	-0.3183E 00	0.1125E 02	0.1406E 02	0.1812E 01	0.1814E 02
10	0.1043E 01	0.2109E 02	0.4218E 01	0.2900E 02	0.4714E 02
11	0.3825E 00	0.1687E 02	-0.3515E 02	0.3082E 02	0.3989E 02
12	-0.2749E 00	0.0000E 00	-0.1265E 02	-0.3626E 01	0.1813E 01

BY BK DATE ____ SUBJECT FAA NAT'L STD SHEET NO ____ OF.
CHKD. BY ____ DATE ____ JOB NO. ____
DEAD LOAD

180' TOWER

TYPE "A" MOD.	= 36" (12)	= 432 K	} 872 K
"B" MOD.	= 40 K (11)	= 440 K	
CABLE ACCESS	2"/FL x 9	=	18
MICROWAVE LEVEL $[.785 \times (50)^2/4 - 150]\ .07^K/_1$ (1960)		=	24
JUNCTION LEVEL $[.785 \times (58)^2/4 - 180]\ .07$		=	34
WALL $54' \times \pi \times 16 \times .015/4$		=	10
WALKWAY $(\overline{20}^2 - \overline{13}^2)\ \pi/4 \times .07$		=	13
WALL $\pi \times 30 \times .2/4$		=	5
CAB FLOOR $\overline{15}^2 \times \pi/4 \times 07$		=	13
CAB ROOF		=	8
CAB WALL $25' \times 16 \times .015$		=	6
MISC			17
	TOTAL D.L.		1020

*<ASSUME NO WEATHER STATION D.L.>

$P/A = 1020/4.000 \times 1000$ = 255 PSI

FAA-STD-017

BY BK DATE ____ SUBJECT FAA UTL. STD SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

180' TOWER <WIND STRESSES IN 15' INCREMENTS>

ELEV.	MC/I	f_c	MC/I	f_c
0	$95,360 \times \frac{1000 \times 60}{9,437,360}$	606	$73,960 \times \frac{1000 \times 64.87}{7,318,582}$	656
15	$82,710 \times .00636$	526	$64,140 \times .00886$	568
30	$70,050 \times$ ✓	445	$54,330 \times$ ✓	482
45	$58,100 \times$ ✓	369	$45,060 \times$ ✓	399
60	$47,020 \times$ ✓	299	$36,470 \times$ ✓	323
75	$36,940 \times$ ✓	235	$28,650 \times$ ✓	254
90	$27,880 \times$ ✓	177	$21,620 \times$ ✓	192
105	$20,150 \times$ ✓	128	$15,630 \times$ ✓	139
120	$13,810 \times$ ✓	89	$10,710 \times$ ✓	95
135	$8,642 \times$ ✓			

BY BK DATE ____ SUBJECT F.A.A. NATIONAL STD. SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____
LIVE LOAD

CABLE ACCESS (ASSUME 4 LOADED)

A = 4x64 = 256 ☐' (1 INDUCED)
4.7x 6.1 2 = 57 } (PLATFORM)
4.7x 11.3 x 2 = 106 }
513 ☐' P = .10 K/☐' x 513 ☐' = 51 K

MICROWAVE LEVEL

$[.785 \times (50)^2_4 - 150]$ .15 K/☐' = 51 K

JUNCTION LEVEL

400 x 1/4 x .150 = 15
8 x 8 x .100 = 6.4
20 x 32 x 2 x .05 = 16.0
= 37.4 K

WALKWAY

$(20^2 - 13^2)\,\pi/4 \times .1$ = 18.6 K

CAB FLOOR

$15^2 \times \pi/4 \times .08$ = 14.9 K

CAB. 200 = = 20.0 K

LL. 192.9 K

(USE 200 K FOR FTG. DESIGN)

BY BC DATE ____ SUBJECT F.A.A. NATIONAL STD SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____
DEAD LOAD + LIVE LOAD

ADDITIONAL FRAMED LEVEL (80' DIA WEATHER STATION OR EQUIVALENT STRUCTURE)

FLOOR D.L. = $[\overline{40}^2 \times \pi/4 - 130^{\square}] .07^{k}/_{\square'}$ = 79^k
ROOF D.L. = $[\overline{44}^2 \times \pi/4 - 120] .06$ = 84^k
WALL $\pi \times 84 \times .15/4$ = 10
$20 \times .15$ = 3
13^k

DEAD LOAD 176^k

FLOOR L.L. = $[\overline{40}^2 \times \pi/4 - 130^{\square}] .10 \times .8$ = 90^k
ROOF L.L. = $[\overline{44}^2 \times \pi/4 - 120] .05$ = 70

LIVE LOAD 160^k

TABULATION OF GRAVITY LOADS (EA. MODULE)

<180' TOWER>
D.L. 1020^k
ADDL D.L. 176
1196^k

L.L. 200
ADDL. L.L 160
360^k

1556^k D.L. + L.L.

<150' TOWER>
$1556 - [2(\overset{152^k}{36+40})] = 1404^k$ D.L. + L.L.

<120' TOWER>
$1556 - [4(\overset{304^k}{36+40})] = 1252^k$ D.L. + L.L.

$P/A = 1556^k/4000^{\square''} = 389$ PSI OK

FAA-STD-017

BY BC DATE ____ SUBJECT FAA NAT'L STD SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ 180' Tower JOB NO ____

WIND LOAD (INCLUDES WEATHER STATION CONTRIBUTION)

Mc/I = ± 656 PSI

* USE 630 PSI W/O WEATHER STATION

PRESTRESS FORCE

P = 14 x 107 = 1500# <14 - 1¼ ϕ STRESS STEEL BARS>

P/A = 1500/4000 = 375 PSI

D.L. + PRESTRESS = 255 + 375 = 630 PSI = 630 PSI
DC

MAX. STRESS

630 ± 630 = 1260 PSI
0 PSI

ELEV. 30' TO 90'

WIND LOAD

Mc/I = ± 482 PSI

PRESTRESS FORCE

P = 10 x 107 = 1070# <10 - 1¼ ϕ STRESS STEEL BARS>

P/A = 1070/4000 = 268 PSI

D.L. + PRESTRESS = 218 + 268 = 486 PSI > 482 PSI

MAX STRESS

486 ± 482 = 968 PSI (+4 PSI)

FAA-STD-017

BY BK DATE ____ SUBJECT FAA NATL STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

180' TOWER

ELEV. +90' & ABOVE

WIND LOAD

MC/I = 177 PSI

P2ES-2ESS FORCE

P = 6 x 107 = 642K

P/A = 642/4.000 = 160 PSI

D.L. + P2ES-2ESS = 138 + 160 ≐ 298 PSI

MAX STRESS

298 ± 177 = +475 PSI
+121 PSI

FAA-STD-017

BY. BLG DATE 12/29/70 SUBJECT SHEET NO. 2 OF.

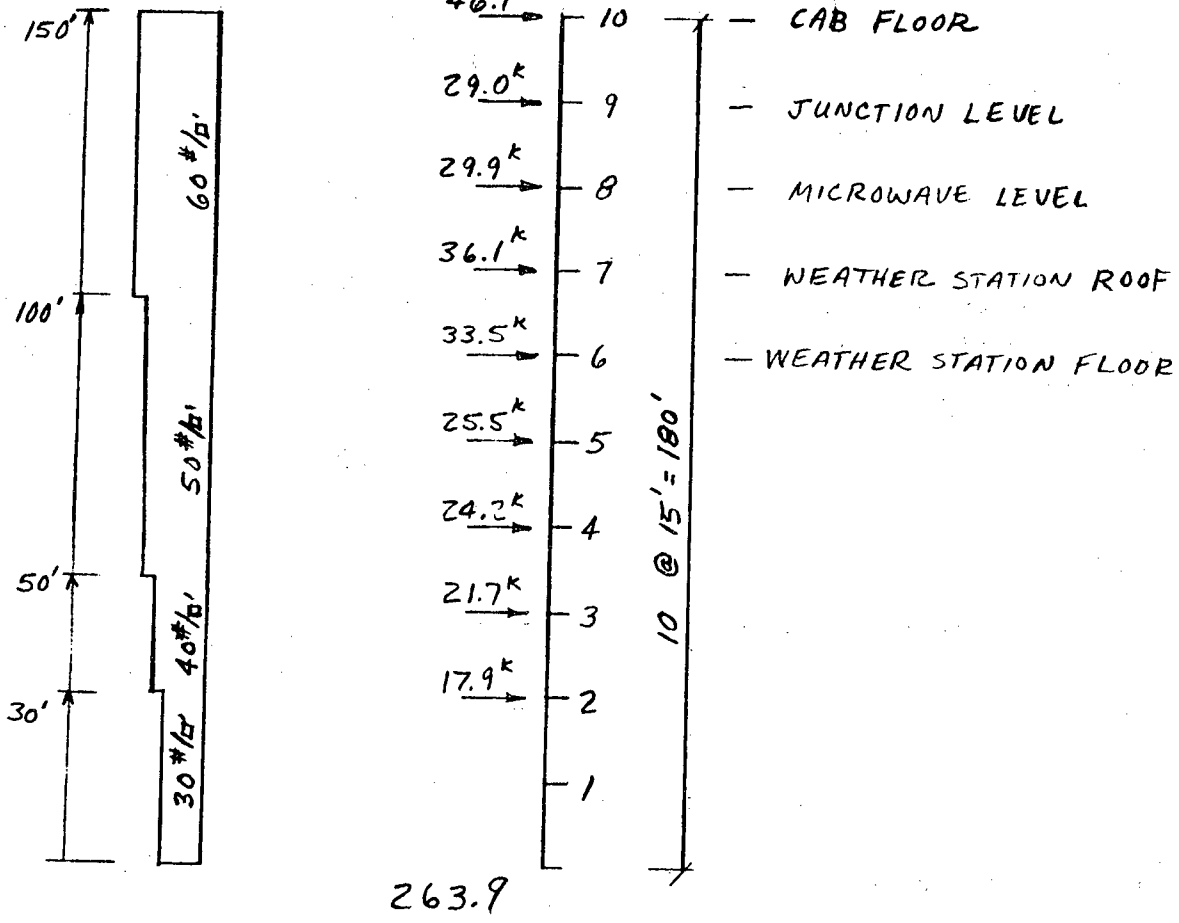
CHKD. BY DATE JOB NO.

150' TOWER

ELEVATION (FT)	WIDTH (FT)	FACTOR	W_p (PSF)	W_p (K)	JOINT LOAD (K)	REMARKS
180						
165	16	0.6	60	8.6		ASDE DOME
150	32 AV.	0.8	60	23.1	46.1	CAB
135	40.	0.8	60	28.8	29.0	JUNCTION
120	54 AV.	0.6	60	29.2	29.9	MICROWAVE
105	34	1.0	60	30.6	30.1	
90	84 AV.	0.6	55 AV.	41.5	33.5	WEATHER STATION
75	34	1.0	50	25.5	25.5	
60	34	1.0	50	25.5	24.2	
45	34	1.0	45 AV.	22.9	21.7	
30	34	1.0	40	20.4	17.9	
15	34	1.0	30	15.3		

BY BLG DATE 12/29/70 SUBJECT FAA TOWER SHEET NO. 1 OF
CHKD. BY DATE JOB NO.

40 PSF WIND PRESSURE 150' TOWER



FAA TOWER - 150 FT. - 40 PSF WIND
BLG - 12/29/70

STORY				
1 HEIGHT	0.1800E 03			
1 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
1 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
1 HOR SHR	0.2639E 06			
2 HEIGHT	0.1800E 03			
2 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
2 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
2 HOR SHR	0.2639E 06			
3 HEIGHT	0.1800E 03			
3 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
3 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
3 HOR SHR	0.2460E 06			
4 HEIGHT	0.1800E 03			
4 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
4 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
4 HOR SHR	0.2243E 06			
5 HEIGHT	0.1800E 03			
5 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
5 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
5 HOR SHR	0.2000E 06			
6 HEIGHT	0.1800E 03			
6 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
6 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
6 HOR SHR	0.1746E 06			
7 HEIGHT	0.1800E 03			
7 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
7 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
7 HOR SHR	0.1411E 06			
8 HEIGHT	0.1800E 03			
8 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
8 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
8 HOR SHR	0.1050E 06			
9 HEIGHT	0.1800E 03			
9 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
9 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
9 HOR SHR	0.7510E 05			
10 HEIGHT	0.1800E 03			
10 BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
10 COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
10 HOR SHR	0.4610E 05			
FIXITY OF COLUMNS AT THE BASE				
	0.1000E 01	0.1000E 01	0.1000E 01	0.1000E 01

DEFLECTIONS AND ROTATIONS FOR LOAD CASE 1

STORY	DEFLECTION	ROTATIONS ----------			
1	-0.3528E-01	-0.3816E-03	-0.3816E-03	-0.3816E-03	-0.3816E-03
2	-0.1336E 00	-0.7005E-03	-0.7005E-03	-0.7005E-03	-0.7005E-03
3	-0.2838E 00	-0.9590E-03	-0.9590E-03	-0.9590E-03	-0.9590E-03
4	-0.4755E 00	-0.1161E-02	-0.1161E-02	-0.1161E-02	-0.1161E-02
5	-0.6990E 00	-0.1314E-02	-0.1314E-02	-0.1314E-02	-0.1314E-02
6	-0.9459E 00	-0.1421E-02	-0.1421E-02	-0.1421E-02	-0.1421E-02
7	-0.1208E 01	-0.1492E-02	-0.1492E-02	-0.1492E-02	-0.1492E-02
8	-0.1481E 01	-0.1533E-02	-0.1533E-02	-0.1533E-02	-0.1533E-02
9	-0.1759E 01	-0.1553E-02	-0.1553E-02	-0.1553E-02	-0.1553E-02
10	-0.2039E 01	-0.1558E-02	-0.1558E-02	-0.1558E-02	-0.1558E-02

$\Delta = 3.04''$

```
LOAD CASE   1
STORY
   MOMENTS
  1 COL TOP -0.5803E 08 -0.5803E 08 -0.7482E 08 -0.7482E 08
  1 COL BOT  0.6840E 08  0.6840E 08  0.8820E 08  0.8820E 08      100'
  1 BM L ND  0.0000E 00  0.0000E 00  0.0000E 00
  1 BM R ND  0.0000E 00  0.0000E 00  0.0000E 00
   SHEARS
  1 COLUMNS  0.5763E 05  0.5763E 05  0.7431E 05  0.7431E 05
  1 BEAMS    0.0000E 00  0.0000E 00  0.0000E 00
  1 P*DELTA  0.0000E 00
   MOMENTS
  2 COL TOP -0.4765E 08 -0.4765E 08 -0.6144E 08 -0.6144E 08
  2 COL BOT  0.5803E 08  0.5803E 08  0.7482E 08  0.7482E 08      115'
  2 BM L ND  0.0000E 00  0.0000E 00  0.0000E 00
  2 BM R ND  0.0000E 00  0.0000E 00  0.0000E 00
   SHEARS
  2 COLUMNS  0.5763E 05  0.5763E 05  0.7431E 05  0.7431E 05
  2 BEAMS    0.0000E 00  0.0000E 00  0.0000E 00
  2 P*DELTA  0.0000E 00
   MOMENTS
  3 COL TOP -0.3798E 08 -0.3798E 08 -0.4897E 08 -0.4897E 08
  3 COL BOT  0.4765E 08  0.4765E 08  0.6144E 08  0.6144E 08      130'
  3 BM L ND  0.0000E 00  0.0000E 00  0.0000E 00
  3 BM R ND  0.0000E 00  0.0000E 00  0.0000E 00
   SHEARS
  3 COLUMNS  0.5372E 05  0.5372E 05  0.6927E 05  0.6927E 05
  3 BEAMS    0.0000E 00  0.0000E 00  0.0000E 00
  3 P*DELTA  0.0000E 00
   MOMENTS
  4 COL TOP -0.2916E 08 -0.2916E 08 -0.3761E 08 -0.3761E 08
  4 COL BOT  0.3798E 08  0.3798E 08  0.4897E 08  0.4897E 08      145'
  4 BM L ND  0.0000E 00  0.0000E 00  0.0000E 00
  4 BM R ND  0.0000E 00  0.0000E 00  0.0000E 00
   SHEARS
  4 COLUMNS  0.4898E 05  0.4898E 05  0.6316E 05  0.6316E 05
  4 BEAMS    0.0000E 00  0.0000E 00  0.0000E 00
  4 P*DELTA  0.0000E 00
   MOMENTS
  5 COL TOP -0.2130E 08 -0.2130E 08 -0.2746E 08 -0.2746E 08
  5 COL BOT  0.2916E 08  0.2916E 08  0.3761E 08  0.3761E 08      160'
  5 BM L ND  0.0000E 00  0.0000E 00  0.0000E 00
  5 BM R ND  0.0000E 00  0.0000E 00  0.0000E 00
   SHEARS
  5 COLUMNS  0.4370E 05  0.4370E 05  0.5634E 05  0.5634E 05
  5 BEAMS    0.0000E 00  0.0000E 00  0.0000E 00
  5 P*DELTA  0.0000E 00
   MOMENTS
  6 COL TOP -0.1443E 08 -0.1443E 08 -0.1861E 08 -0.1861E 08
  6 COL BOT  0.2130E 08  0.2130E 08  0.2746E 08  0.2746E 08      175
  6 BM L ND  0.0000E 00  0.0000E 00  0.0000E 00
  6 BM R ND  0.0000E 00  0.0000E 00  0.0000E 00
   SHEARS
  6 COLUMNS  0.3813E 05  0.3813E 05  0.4916E 05  0.4916E 05
```

6 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
6 P*DELTA	0.0000E 00			
MOMENTS				
7 COL TOP	-0.8892E 07	-0.8892E 07	-0.1146E 08	-0.1146E 08
7 COL BOT	0.1443E 08	0.1443E 08	0.1861E 08	0.1861E 08
7 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
7 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
SHEARS				
7 COLUMNS	0.3081E 05	0.3081E 05	0.3973E 05	0.3973E 05
7 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
7 P*DELTA	0.0000E 00			
MOMENTS				
8 COL TOP	-0.4764E 07	-0.4764E 07	-0.6143E 07	-0.6143E 07
8 COL BOT	0.8892E 07	0.8892E 07	0.1146E 08	0.1146E 08
8 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
8 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
SHEARS				
8 COLUMNS	0.2293E 05	0.2293E 05	0.2956E 05	0.2956E 05
8 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
8 P*DELTA	0.0000E 00			
MOMENTS				
9 COL TOP	-0.1812E 07	-0.1812E 07	-0.2336E 07	-0.2336E 07
9 COL BOT	0.4764E 07	0.4764E 07	0.6143E 07	0.6143E 07
9 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
9 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
SHEARS				
9 COLUMNS	0.1640E 05	0.1640E 05	0.2114E 05	0.2114E 05
9 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
9 P*DELTA	0.0000E 00			
MOMENTS				
10 COL TOP	0.9843E 01	0.0000E 00	0.9065E 01	0.1087E 02
10 COL BOT	0.1812E 07	0.1812E 07	0.2336E 07	0.2336E 07
10 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
10 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
SHEARS				
10 COLUMNS	0.1006E 05	0.1006E 05	0.1298E 05	0.1298E 05
10 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
10 P*DELTA	0.0000E 00			

190'

205'

220'

235'

EQUILIBRIUM CHECK - UNBALANCED FORCES

LOAD CASE 1

STORY	SHEAR	MOMENTS --------			
1	0.7324E-03	0.1062E 01	0.1062E 01	-0.8125E 00	-0.4375E 00
2	0.2856E-01	0.1062E 01	0.1062E 01	-0.1812E 01	0.9375E 00
3	-0.6225E-01	-0.7187E 00	0.1437E 01	-0.4500E 01	-0.9062E 00
4	-0.1071E 00	-0.4906E 01	-0.2125E 01	-0.5437E 01	-0.6343E 01
5	-0.1264E 00	0.0000E 00	-0.7031E 00	-0.7250E 01	0.1812E 01
6	0.1557E 00	-0.4921E 01	-0.7031E 00	-0.1268E 02	-0.2718E 01
7	-0.3173E 00	0.7031E 00	-0.3515E 01	0.0000E 00	-0.7250E 01
8	0.4522E 00	0.4218E 01	-0.9843E 01	0.1269E 02	0.1632E 02
9	-0.7934E-03	0.8437E 01	-0.1406E 01	-0.1810E 01	0.7253E 01
10	0.3936E 00	0.9843E 01	0.0000E 00	0.9065E 01	0.1087E 02

FAA-STD-017

BY 3K DATE ____ SUBJECT FA.A. NAT'L. STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

150' TOWER <WIND STRESSES IN 15' INCREMENTS>

ELEV.	MC/I	f_c	MC/I	f_c
0	$88,200 \times \frac{1000 \times 60}{9,437,367}$	561	$68,400 \times \frac{1000 \times 64.87}{7318,582}$	606
15	$74,820 \times .00636$	476	$58,030 \times .00886$	514
30	$61,440 \times$ ✓	391	47,650 ✓	422
45	$48,970 \times$ ✓	311	37,980 ✓	336
60	$37,610 \times$ ✓	239	29,160 ✓	258
75	$27,460 \times$ ✓	174	21,300 ✓	189
* 90	$18,610 \times$ ✓	118	14,430 ✓	128
105	$11,460 \times$ ✓	73	8892 ✓	79
120				

* USE 6 BAR PATTERN MIN. ABOVE ELEV 90'

BY BK DATE ____ SUBJECT FA.A NAT'L STD SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

(150' TOWER 0'-0 TO 30'-0)

WIND LOAD (INCLUDES WEATHER STATION CONTRIBUTION)

$MC/I = \pm 606$ PSI

* USE 580 PSI W/O WEATHER STATION

PRESTRESS FORCE

$P = 14 \times 107 = 1500^{\#}$ <14 - 1¼ ϕ STRESS STEEL BARS>

$P/A = 1500/4.000 = 375$ PSI

D.L. + PRESTRESS = 217 + 375 = 592 PSI > 580 PSI O.K.

MAX STRESS

$592 \pm 580 = +1170$ PSI
$+ 12$ PSI.

ELEV 30' TO 90'

WIND LOAD

$MC/I = \pm 422$ PSI

PRESTRESS FORCE

$P = 10 \times 107 = 1070$ <10 - 1¼ ϕ STRESS STEEL BARS>

$P/A = 1070/4.000 = 268$ PSI

D.L. + PRESTRESS = 180 + 268 = 448 > 422 PSI

MAX. STRESS

$448 \pm 422 = 870$ PSI
26 PSI

FAA-STD-017

BY 3K DATE ____ SUBJECT FAA NAT'L STD SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

150' TOWER (DEAD LOAD)

TYPE 'A' MOD.	36	x 10	=	360 }	720K
'B' MOD.	40	x 9	=	360 }	
CABLE ACCESS	2K/FL	x 7	=		18
MICROWAVE LEVEL					24
JUNCTION					34
WALL					10
WALKWAY					13
WALL					5
CAB FLOOR					13
CAB ROOF					8
CAB WALL					6
MISC					17
			TOTAL D.L.		868 *

*< ASSUMES NO WEATHER STATION D.L. >

$P/A = 868/4000 \times 1000 = 217$ psi

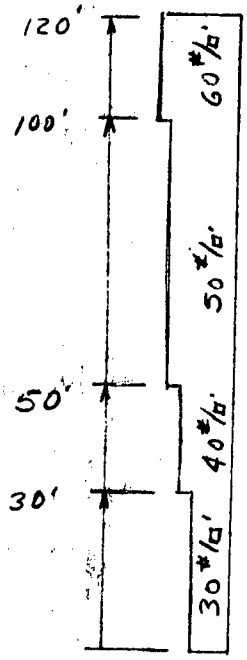
335

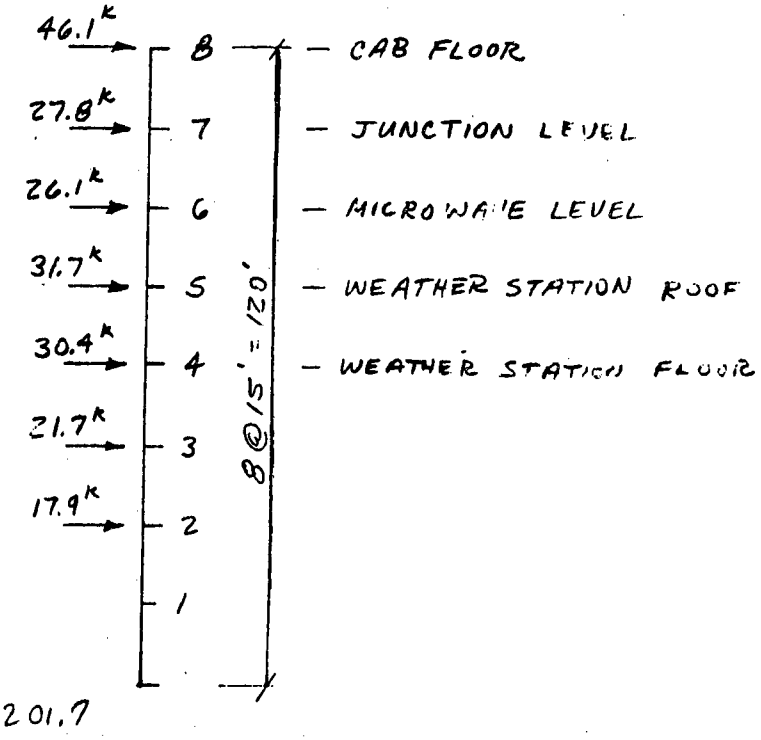
FAA-STD-017

BY BLG DATE 12/29/74 SUBJECT FAA TOWER SHEET NO 1 OF

CHKD. BY DATE JOB NO.

40 PSF WIND PRESSURE 120' TOWER





FAA-STD-017

BY BLG DATE 12/29/70 SUBJECT _____ SHEET NO. 2 OF _____

CHKD. BY _____ DATE _____ JOB NO. _____

ELEV. (FT)	WIDTH (FT)	FACTOR	W_p (PSF)	$\dot{W}_p$ (K)	JOINT LOAD (K)	REMARKS
150						
	16	0.6	60	8.6		ASDE DOME
135						
	32 AV.	0.8	60	23.1		CAB
120					46.1	
	40	0.8	60	28.8		JUNCTION
105					27.8	
	54 AV.	0.6	55 AV	26.7		MICROWAVE
90					26.1	
	34	1.0	50	25.5		
75					31.7	
	84 AV	0.6	50	37.8		WEATHER STATION
60					30.4	
	34	1.0	45 AV	22.9		
45					21.7	
	34	1.0	40	20.4		
30					17.9	
	34	1.0	30	15.3		
15						

FAA TOWER - 120 FT. - 40 PSF WIND
BLG - 12/29/70

STORY					
1	HEIGHT	0.1800E 03			
1	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
1	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
1	HOR SHR	0.2017E 06			
2	HEIGHT	0.1800E 03			
2	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
2	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
2	HOR SHR	0.2017E 06			
3	HEIGHT	0.1800E 03			
3	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
3	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
3	HOR SHR	0.1838E 06			
4	HEIGHT	0.1800E 03			
4	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
4	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
4	HOR SHR	0.1621E 06			
5	HEIGHT	0.1800E 03			
5	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
5	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
5	HOR SHR	0.1317E 06			
6	HEIGHT	0.1800E 03			
6	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
6	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
6	HOR SHR	0.1000E 06			
7	HEIGHT	0.1800E 03			
7	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
7	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
7	HOR SHR	0.7390E 05			
8	HEIGHT	0.1800E 03			
8	BEAM I	0.0000E 00	0.0000E 00	0.0000E 00	
8	COLUM I	0.7319E 07	0.7319E 07	0.9437E 07	0.9437E 07
8	HOR SHR	0.4610E 05			
FIXITY OF COLUMNS AT THE BASE					
		0.1000E 01	0.1000E 01	0.1000E 01	0.1000E 01

DEFLECTIONS AND ROTATIONS FOR LOAD CASE 1

STORY	DEFLECTION	ROTATIONS			
1	-0.2207E-01	-0.2373E-03	-0.2373E-03	-0.2373E-03	-0.2373E-03
2	-0.8256E-01	-0.4268E-03	-0.4268E-03	-0.4268E-03	-0.4268E-03
3	-0.1729E 00	-0.5705E-03	-0.5705E-03	-0.5705E-03	-0.5705E-03
4	-0.2854E 00	-0.6732E-03	-0.6732E-03	-0.6732E-03	-0.6732E-03
5	-0.4132E 00	-0.7410E-03	-0.7410E-03	-0.7410E-03	-0.7410E-03
6	-0.5506E 00	-0.7813E-03	-0.7813E-03	-0.7813E-03	-0.7813E-03
7	-0.6933E 00	-0.8011E-03	-0.8011E-03	-0.8011E-03	-0.8011E-03
8	-0.8381E 00	-0.8065E-03	-0.8065E-03	-0.8065E-03	-0.8065E-03

$\Delta = 0.84"$

LOAD CASE 1

STORY					
	MOMENTS				
1	COL TOP	-0.3535E 08	-0.3535E 08	-0.4558E 08	-0.4558E 08
1	COL BOT	0.4328E 08	0.4328E 08	0.5580E 08	0.5580E 08
1	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
1	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
1	COLUMNS	0.4405E 05	0.4405E 05	0.5679E 05	0.5679E 05
1	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
1	P*DELTA	0.0000E 00			
	MOMENTS				
2	COL TOP	-0.2742E 08	-0.2742E 08	-0.3536E 08	-0.3536E 08
2	COL BOT	0.3535E 08	0.3535E 08	0.4558E 08	0.4558E 08
2	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
2	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
2	COLUMNS	0.4405E 05	0.4405E 05	0.5679E 05	0.5679E 05
2	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
2	P*DELTA	0.0000E 00			
	MOMENTS				
3	COL TOP	-0.2019E 08	-0.2019E 08	-0.2604E 08	-0.2604E 08
3	COL BOT	0.2742E 08	0.2742E 08	0.3536E 08	0.3536E 08
3	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
3	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
3	COLUMNS	0.4014E 05	0.4014E 05	0.5175E 05	0.5175E 05
3	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
3	P*DELTA	0.0000E 00			
	MOMENTS				
4	COL TOP	-0.1382E 08	-0.1382E 08	-0.1782E 08	-0.1782E 08
4	COL BOT	0.2019E 08	0.2019E 08	0.2604E 08	0.2604E 08
4	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
4	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
4	COLUMNS	0.3540E 05	0.3540E 05	0.4564E 05	0.4564E 05
4	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
4	P*DELTA	0.0000E 00			
	MOMENTS				
5	COL TOP	-0.8648E 07	-0.8648E 07	-0.1115E 08	-0.1115E 08
5	COL BOT	0.1382E 08	0.1382E 08	0.1782E 08	0.1782E 08
5	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
5	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
5	COLUMNS	0.2876E 05	0.2876E 05	0.3708E 05	0.3708E 05
5	BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
5	P*DELTA	0.0000E 00			
	MOMENTS				
6	COL TOP	-0.4717E 07	-0.4717E 07	-0.6082E 07	-0.6082E 07
6	COL BOT	0.8648E 07	0.8648E 07	0.1115E 08	0.1115E 08
6	BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
6	BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
	SHEARS				
6	COLUMNS	0.2183E 05	0.2183E 05	0.2816E 05	0.2816E 05

100'

115'

130'

145'

160'

175'

6 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
6 P*DELTA	0.0000E 00			
MOMENTS				
7 COL TOP	-0.1812E 07	-0.1812E 07	-0.2336E 07	-0.2336E 07
7 COL BOT	0.4717E 07	0.4717E 07	0.6082E 07	0.6082E 07
7 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
7 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
SHEARS				
7 COLUMNS	0.1613E 05	0.1613E 05	0.2081E 05	0.2081E 05
7 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
7 P*DELTA	0.0000E 00			
MOMENTS				
8 COL TOP	-0.2109E 01	0.1406E 01	0.1813E 01	0.1813E 01
8 COL BOT	0.1812E 07	0.1812E 07	0.2336E 07	0.2336E 07
8 BM L ND	0.0000E 00	0.0000E 00	0.0000E 00	
8 BM R ND	0.0000E 00	0.0000E 00	0.0000E 00	
SHEARS				
8 COLUMNS	0.1006E 05	0.1006E 05	0.1298E 05	0.1298E 05
8 BEAMS	0.0000E 00	0.0000E 00	0.0000E 00	
8 P*DELTA	0.0000E 00			

190'

205'

EQUILIBRIUM CHECK - UNBALANCED FORCES

LOAD CASE 1

STORY	SHEAR	MOMENTS --------			
1	0.2319E-02	0.1250E 00	0.3125E 00	-0.5312E 00	-0.5312E 00
2	-0.4028E-02	-0.8750E 00	-0.7187E 00	-0.2031E 01	0.3125E-01
3	-0.5749E-01	-0.1406E 01	0.1781E 01	-0.1812E 01	-0.4531E 00
4	-0.2746E-01	0.1765E 01	0.2109E 01	0.9218E 00	-0.1812E 01
5	0.2648E-01	0.3515E 01	-0.2460E 01	0.9140E 00	0.2726E 01
6	0.4833E-01	0.7031E 00	0.1406E 01	0.3625E 01	0.6351E 01
7	0.2156E 00	0.5625E 01	0.5625E 01	0.4533E 01	0.1814E 01
8	0.7952E-01	-0.2109E 01	0.1406E 01	0.1813E 01	0.1813E 01

FAA-STD-017

BY BK DATE ____ SUBJECT FAA. NATL. STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

120' TOWER <WIND STRESSES IN 15' INCREMENTS>

ELEV.	Mc/I,	f_c	Mc/I	f_c
0	55,800 $\times \frac{1000 \times 60}{9,437,367}$	355	43,280 $\times \frac{1000 \times 64.87}{7,318,582}$	383
15	45,580 $\times$ .00636	290	35,350 $\times$ .00886	313
30	35,360 $\times$ ✓	225	27,420 $\times$ ✓	243
45	26,040 $\times$ ✓	165	20,190 $\times$ ✓	179
60	17,820 $\times$ ✓	113	13,820 $\times$ ✓	122
75	11,150 $\times$ ✓	71	8,648 $\times$ ✓	77
90				
105				

BY BK DATE ____ SUBJECT FAA NAT'L STD. SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

120' TOWER (DEAD LOAD)

TYPE "A" MOD.	= 36 (8)	= 288	568 K
"B" MOD.	= 40 (7)	= 280	
CABLE ACCESS	2 K/FL x 5		10
MICROWAVE LEVEL			24
JUNCTION			34
WALL			10
WALKWAY			13
WALL			5
CAB FLOOR			13
CAB ROOF			8
CAB WALL			6
MISC.			17
		TOTAL D.L.	708 K*

*< ASSUME NO WEATHER STATION D.L. >

$P/A = 708/4000 \times 1000 = 177$ psi

FAA-STD-017

BY B— DATE ____ SUBJECT FAA N&T'L STD. SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ 120 TOWER JOB NO. ____

ELEV. 0'-0 TO 60'-0

WIND LOAD (INCLUDES WEATHER STATION CONTRIBUTION)

$Mc/I = \pm 383$ PSI

PRESTRESS FORCE

$P = 10 \times 107 = 1070^{K}$ (10-1¼"φ STRESS STEEL BARS)

$P/A = 1070/4.000 = 268$ PSI

D.L. + PRESTRESS $177 + 268 = 445$ PSI > 383 O.K.

MAX STRESS

$445 \pm 383 = 828$ PSI
62 PSI

ABOVE ELEV. 60'

$Mc/I = \pm 122$ PSI

PRESTRESS FORCE

$P = 6 \times 107 = 642^{K}$

$P/A = 642/4.000 = 160$ PSI

D.L. + PRESTRESS $= 99$ PSI $+ 160 = 259$ PSI > 160 PSI

MAX STRESS

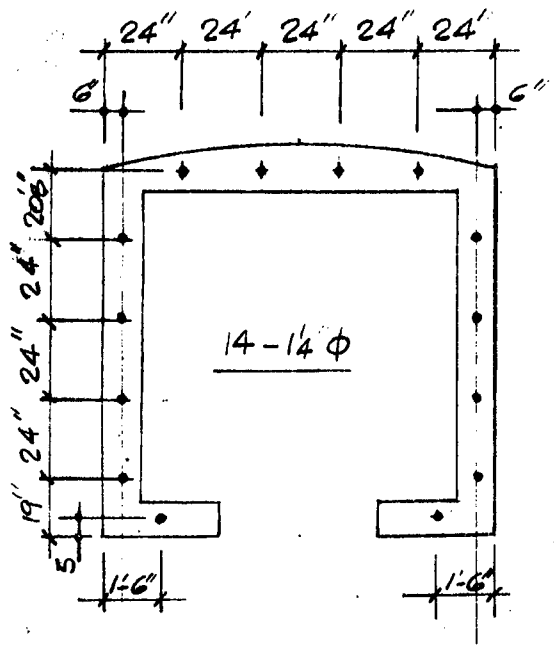
$259 \pm 160 = 410$ PSI
99 PSI

445

BY BK DATE ____ SUBJECT F.A.A NATIONAL STD SHEET NO. ____ OF ____

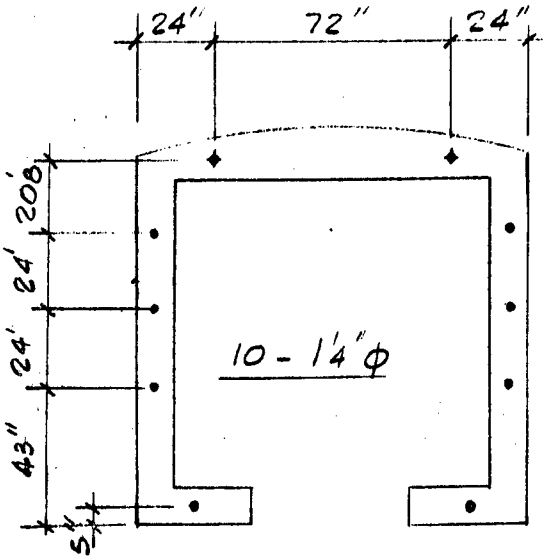
CHKD. BY ____ DATE ____ JOB NO. ____

POST TENSION STRAND PATTERN



4 x 111	=	444
2 x 91	=	182
2 x 67	=	134
2 x 43	=	86
2 x 19	=	38
2 x 5	=	10
		894

$\bar{x} = 894/14 = 63.9" \simeq 64.9"$



2 x 111	=	222
2 x 91	=	182
2 x 67	=	134
2 x 43	=	86
2 x 5	=	10
		634

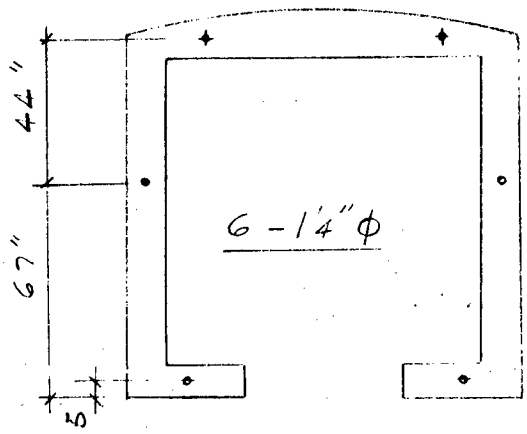
$\bar{x} = 634/10 = 63.4' \simeq 64.9$

FAA-STD-017

BY BK DATE ____ SUBJECT FAA NATIONAL STD SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

POST TENSION STRAN PATTERN



$2 \times 111 = 222$

$2 \times 67 = 134$

$2 \times 5 = 10$

366

$\bar{X} = 366/6 = 61''$

$\frac{Pe\,C}{I} = \frac{3.9 \times 642 \times 64.9 \times 10^3}{7,318,582}$

$= \pm 22$ PSI (NEG.)

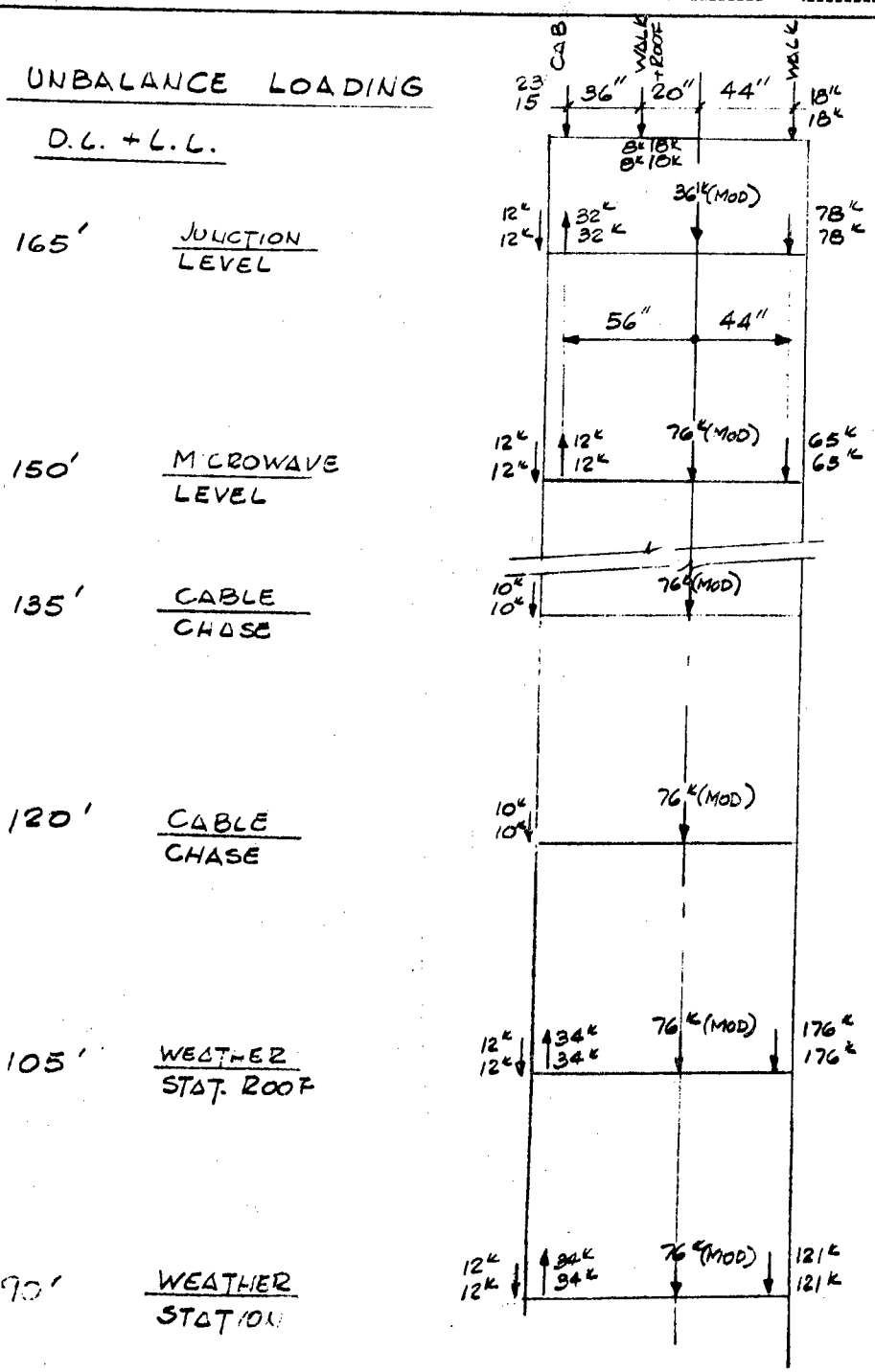
FAA-STD-017

BY BK DATE ____ SUBJECT FAA NATIONAL STD. 180' TOWER MODULE DESIGN SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

UNBALANCE LOADING

D.L. + L.L.



165' JUNCTION LEVEL

150' MICROWAVE LEVEL

135' CABLE CHASE

120' CABLE CHASE

105' WEATHER STAT. ROOF

90' WEATHER STATION

485

BY BK DATE ____ SUBJECT FAA TOWER SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

BEARING PL

(DOUBLE PL ARRANGEMENT)

TOP PL 7" x 6" w/ 2"φ WEDGE HOLE

BOT. PL 8" x 6" w/ 3"φ HOLE

$A_{TOP} = 42 - (.785 \times 4) = 38.86$ in²

$f = 107/38.86 = 2.75$ KSI FULL

$125/38.86 = 3.21$ KSI INIT LC

$A_{BOT} = 48 - (.785 \times 4) = 40.94$ KSI

$f = 107/40.94 = 2.62$ KSI FULL

$125/40.94 = 3.07$ KSI INIT LC

$M_{TOP} = 3.21 \times (3.5)^2/2 = 10.08$ in-k

$S_{req} = 10.08/27 = .373$ in³/in

$M_{BOT} = 3.07 \times (3.75)^2/2 = 11.6$ in-k

$S_{req} = 11.6/27 = .43$ in³/in

USE $1\frac{3}{4}$" PL $S_{pl} = 0.51$ in³/in

TOP PL 7" x 6" x $1\frac{3}{4}$"

BOT PL 8 x 6 x $1\frac{3}{4}$"

BY BK DATE ____ SUBJECT FAA NATIONAL STD 180' TOWER MODULE DESIGN SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

<P> D.L + L.L.

23 + 15 + 16 + 36 + 36	=	126
24 - 64 + 36 + 78 + 78	=	152
24 - 24 + 76 + 65 + 65	=	206
20 + 76	=	96
20 + 76	=	96
24 - 68 + 76 + 176 + 176	=	384
24 - 68 + 76 + 121 + 121	=	274
		1334 K

<M> D.L. + L.L.

(23+15) (56)	=	2,128 "K
(16 + 36) (20)	=	1,040
- (36) (44)	=	-1,584
(24) (65)	=	1,560
- (64) (56)	=	-3,584
- (78+78) (44)	=	-6,864
(24) (65)	=	1,560
-(24) (56)	=	-1,344
-(130) (44)	=	-5,720
(20) (2) (65)	=	2,600
(24) (2) (65)	=	3,120
-(68) (2) (56)	=	-7,616
- (176) (2) (44)	=	-15,488
- (121) (2) (44)	=	-10,648
		-37,672 "K

$P/A = 1334/4000 \times 1000 = 334$ PSI

$MC/I = 37{,}672 \times 48/7318.6 = 247$ PSI

$-MC/I = 37{,}672 \times 65/7318.6 = -336$ PSI

$P/A =$ +160 PSI (6 BAR - PRESTRESS)

$f_c = 334 + 160 + 247 = 741$ PSI (132)

$f_c = 334 + 160 - 336 = 158$ PSI

495

FAA-STD-017

BY BK DATE ____ SUBJECT FAA NATIONAL STD. 180' TOWER MODULE DESIGN SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

D.L. + PART. L.L. + W.L.

1. USE .8 D.L + L.L. FACTOR
2. ASSUME MAX. UNBALANCE OF LD. @ 75' LEVEL.

$P = .8 \times 1366^{K} = 1090^{K}$

$M = .8 \times 37,672^{"K} = 30,138^{"K}$

$P/A = 1090/4000 \times 1000$	$= 273$ PSI		D.L. + PART. L.L.
$M/S = 30,138 \times 48/7318.6$	$= +198$ PSI		D.L. + PART. L.L.
$M/S = 30,138 \times 65/7318.6$	$= -268$ PSI		D.L. + PART. L.L.
$M/S =$	$= \pm 254$ PSI		W.L.
$P/A = 10 \times 107/4.$	$= +268$ PSI		PRESTRESS (10 BAR)

P/A	M/S (LL+DL)	M/S (W.L.)	P/A (PRESTRESS)		
+273	-268	±254	268	= 19 PSI	527 PSI
+273	+198	±188	268	= 551 PSI	927 PSI

<USE 10 BAR PATTERN TO ELEV. +90'>

FAA-STD-017

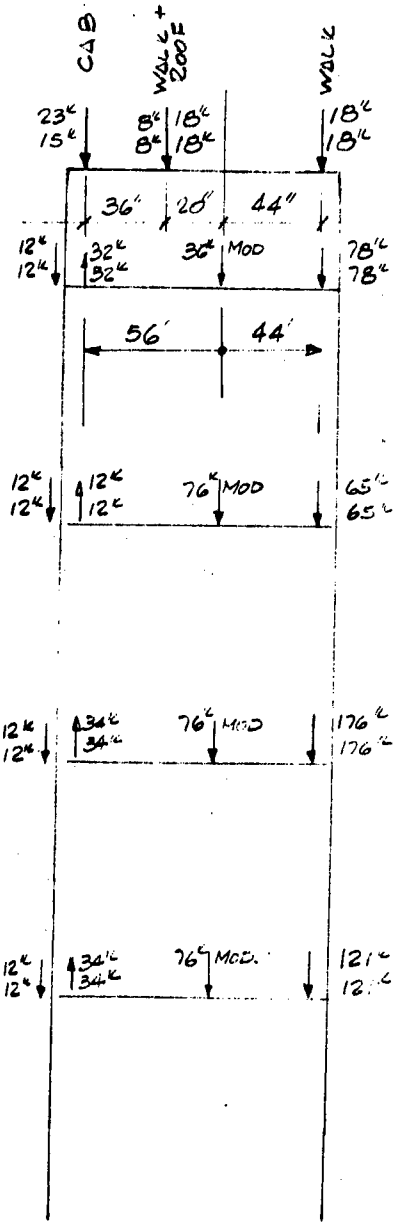
BY BK DATE
CHKD. BY DATE

SUBJECT FAA NATIONAL STD. 150' TOWER MODULE DESIGN

SHEET NO. OF
JOB NO.

UNBALANCE LOADING

D.L. + L.L.



135' JUNCTION LEVEL

120' MICROWAVE LEVEL

105' WEATHER STAT. ROOF

90' WEATHER STATION

FAA-STD-017

BY BK DATE ____ SUBJECT FAA NATIONAL STD 150' TOWER SHEET NO. ____ OF ____
CHKD BY ____ DATE ____ JOB NO. ____

<P> D.L. + L.L.

23 + 15 + 16 + 36 + 36	=	126
24 - 64 + 36 + 78 + 78	=	152
24 - 24 + 76 + 65 + 65	=	206
24 - 68 + 76 + 176 + 176	=	384
24 - 68 + 76 + 121 + 121	=	274
		1142 K

<M> D.L. + L.L.

(23+15)	(56)	= 2,128
(16+36)	(20)	= 1,040
(-36)	(44)	= -1,584
(24)	(65)	= 1,560
(-64)	(56)	= -3,584
-(78+78)	(44)	= -6,864
(24)	(65)	= 1,560
-(24)	(56)	= -1,344
-(130)	(44)	= -5,720
(24)	(65)	= 1,560
-(68)	(56)	= -3,808
-(176)(2)	(44)	= -15,488
(24)	(65)	= 1,560
-(68)	(56)	= -3,808
-(121)(2)	(44)	= -10,648
		43,440 IK

$P/A = 1142/4000 \times 1000 = 286$ PSI

$MC/I = 43{,}440 \times 48/7318.6 = 285$

$MC/I = 43{,}440 \times 65/7318.6 = -386$

$P/A = +160$ PSI (6 BOR - PRESTRESS)

$f_c = 286 + 160 + 285 = 731$ PSI

$f_c = 286 + 160 - 386 = 60$ PSI (U.S.)

525

BY BK DATE ____ SUBJECT FAA NATIONAL STD. 150' TOWER MODULE DESIGN SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

D.L. + PART. L.L. + W.L.

1. USE .8 D.L. + L.L. FACTOR
2. ASSUME MAX UNBALANCE OF LD. @ 75' LEVEL

$P = .8 \times 1142^{K} = 915^{K}$
$M = .8 \times 43{,}440 = 34{,}800''^{K}$

P/A	$= 915/4000 \times 1000$	$= 229$	PSI	D.L. + PART. L.L.
M/S	$= 34{,}800 \times 48/7318.6$	$= 228$	PSI	D.L. + PART. L.L.
M/S	$= 34{,}800 \times 65/7318.6$	$= -309$	PSI	D.L. + PART. L.L.
M/S	$=$	$= \pm 189$	PSI	W.L.
P/A		$= +268$	PSI	PRESTRESS (10 BAR)

P/A	M/S (UNBAL)	M/S (W.L.)	P/A (PRESTRESS)	
+229	− 309	± 189	+268	= −1PSI +377PSI
229	+ 228	± 140	+268	= 585PSI 865PSI

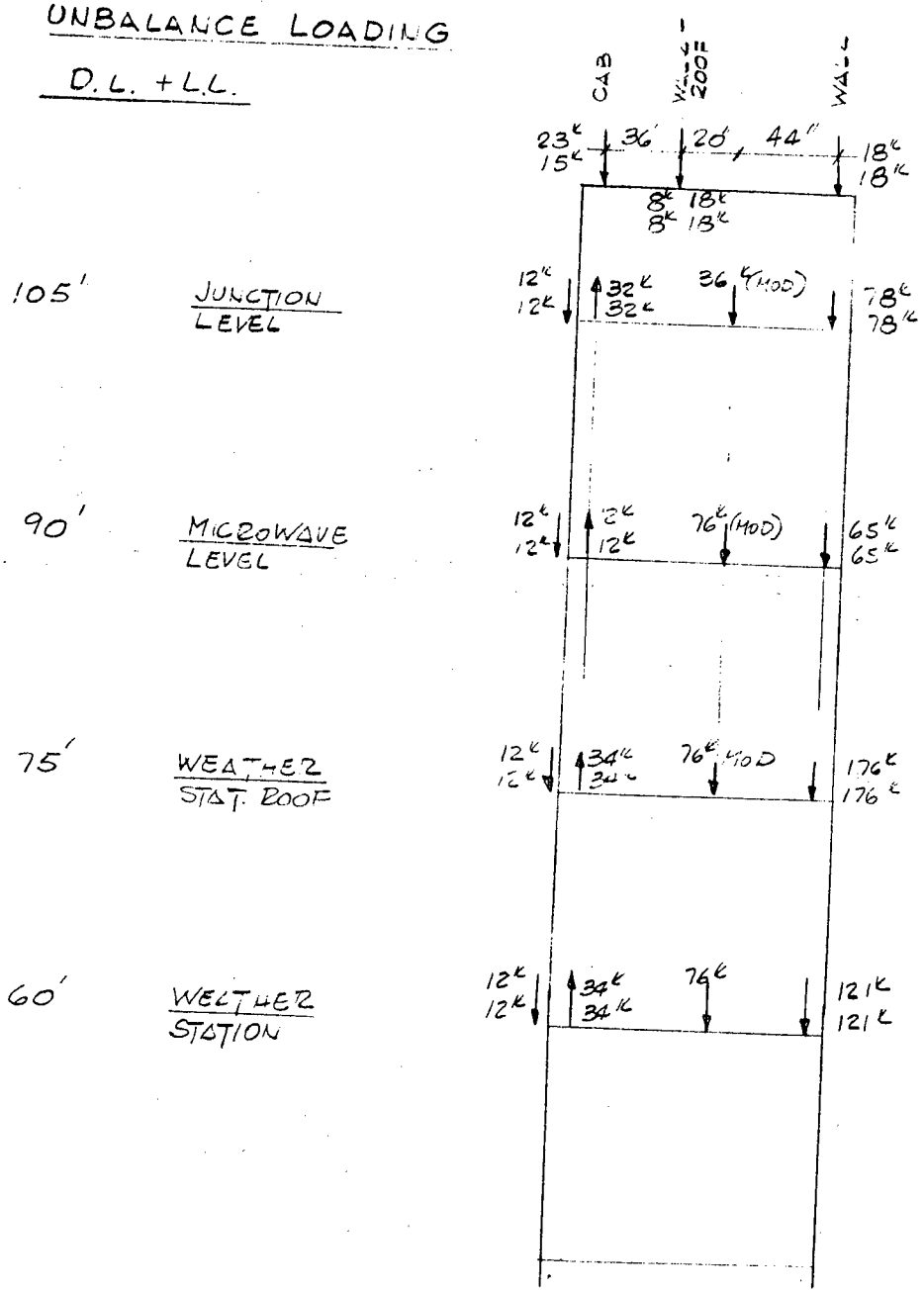
(USE 10 BAR PATTERN TO +90 ELEV.)

FAA-STD-017

BY BK DATE
CHKD. BY DATE
SUBJECT FAA NATIONAL STD. 120' TOWER MODULE DESIGN
SHEET NO. OF
JOB NO.

UNBALANCE LOADING

D. L. + L. L.



BY BL DATE
CHKD. BY DATE
SUBJECT FAA NATIONAL STD. 120' TOWER MODULE
SHEET NO. OF
JOB NO.

<P> D.L. + L.L.

23 + 15 + 16 + 36 − 36	=	126 K
24 − 64 + 36 + 78 + 78	=	152 K
24 − 24 + 76 + 65 + 65	=	206 K
24 − 68 + 76 + 176 + 176	=	384 K
24 − 68 + 76 + 61 + 121	=	274 K
		1142 K

<M> D.L. − L.L.

(23+15)	(56)	= 2,128
(16+36)	(20)	= 520
(−36)	(44)	= −1,584
(24)	(65)	= 1,560
(−64)	(56)	= −3,584
−(78)(2)	(44)	= −6,864
(24)	(65)	= 1,560
−(24)	(56)	= −1,344
−(130)	(44)	= −5,720
(24)	(65)	= 1,560
−(68)	(56)	= 3,808
−(176)(2)	(44)	= −15,488
24	(65)	= 1,560
−68	(56)	= 3,808
−(121)(2)	(44)	= 10,648
		43,440

$P/A = 1142/4000 \times 1000 = 286$ PSI

$MC/I = 43,440 \times 48/7318.6 = 285$ PSI

$-MC/I = 43,440 \times 65/7318.6 = -386$ PSI

$P/A = +160$ PSI (6BL2 - PRESTRESS)

$f_c = 286 + 160 + 285 = 731$ PSI

$f_c = 286 + 160 - 386 = 60$ PSI

555

BY_____DATE_____ SUBJECT FAA NATIONAL E-D. SHEET NO._____OF_____
CHKD. BY_____DATE_____ 120' TOWER JOB NO._____
MODULE DESIGN

D.L. + PART. L.L. + W.L.

1. USE .8 D.L. + L.L. FACTOR
2. ASSUME MAX. UNBALANCE OF LD. @ 45' LEVEL

P = .8 x 1142 = 915 K
M = .8 x 43 440 = 34,800 K

P/A	= 915,4000 x 1000	= 229 PSI	D.L. + PART. L.L.
M/S	= 34,800 x 48/7318.6	= 228 PSI	D.L. + PART. L.L.
M/S	= 34 800 x 65/7318.6	= -309 PSI	D.L. + PART. L.L.
M/S	=	= ± 179 PSI	W.L.
P/A	=	+ 268 PSI	PRESTRESS (10 BLR)

P/A	M/S (D.L.)	M/S (W.L.)	P/A (PRESTRESS)	
+ 229	- 309	± 179	+ 268	= + 9PSI, 367PSI
+ 229	+ 228	± 132	+ 268	= +593PSI, 857PSI

< USE 10 BAR PATTERN TO ELEV. +60'-0 >

BY BK DATE ____ SUBJECT FAA NATIONAL STD SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO ____
FOUNDATION DESIGN

SOIL BEARING 4000 PSF

MODULE LOADING <180' TOWER>

D.L.	1196 K	USE 1200 K
L.L.	288 K	USE 300 K
WIND LD.	73,960 K 95,360 K	

DESIGN CRITERIA

D.L. + L.L BEARING	≥	4000 PSF
D.L. + LL/2 ± W.L. BEARING	≥	5333 PSI
D.L. ± W.L BEARING	≥	5333 PSI

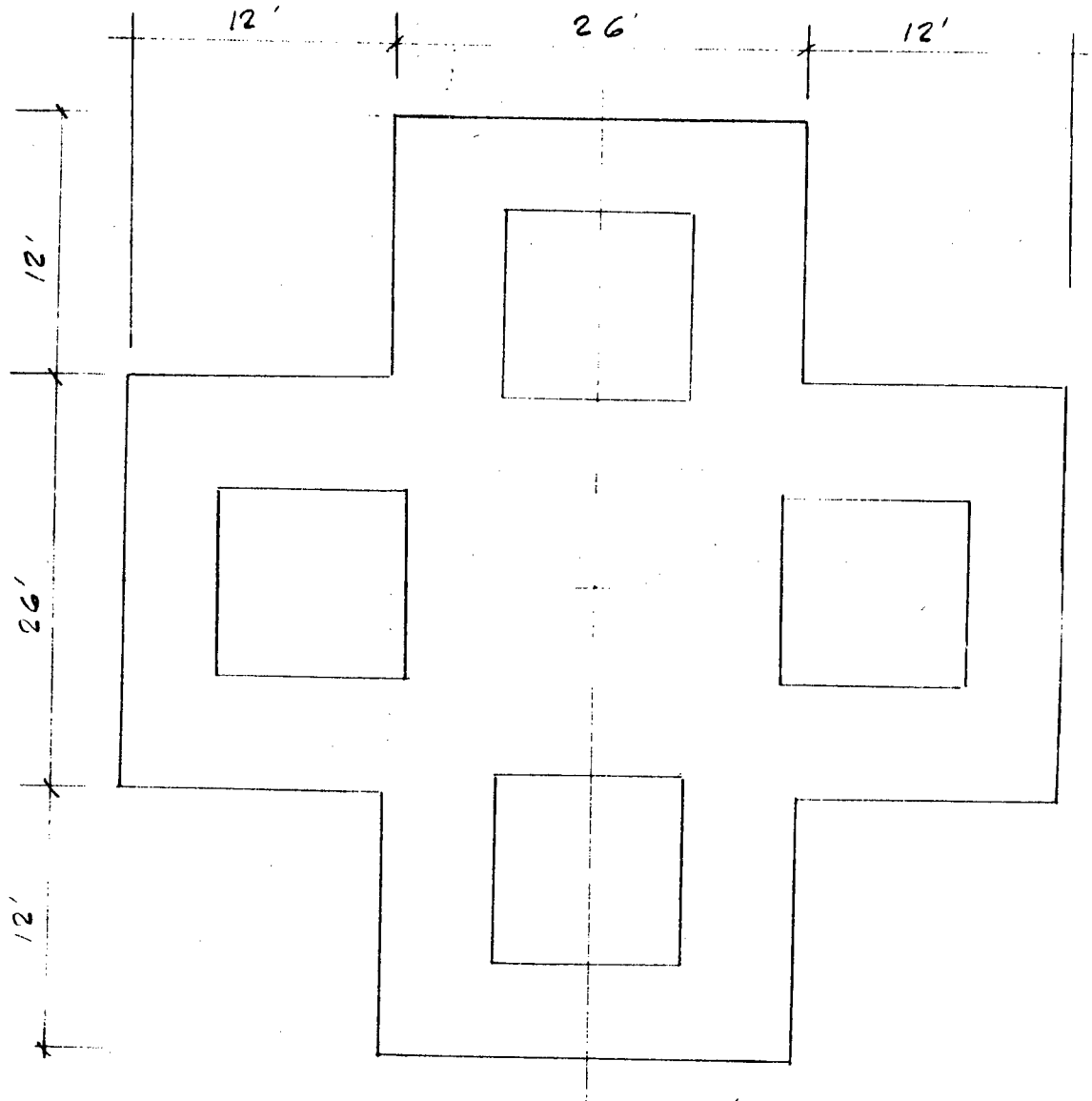
P/A (D.L.) $= 6000/1824 = 3290$ PSF < 4000 PSI

FAA-STD-017

BY_____DATE_____ SUBJECT FAA NATIONAL STD. SHEET NO._____OF_____

CHKD. BY_____DATE_____ JOB NO._____

FOUNDATION DESIGN



$A = 50 \times 50 - (4 \times 12 \times 12) = 1824^{0}$'

$I = 50 \times (50)^3/12 = 520\,833$

$-12 \times (12)^3/12 \times 4 = -6,912$

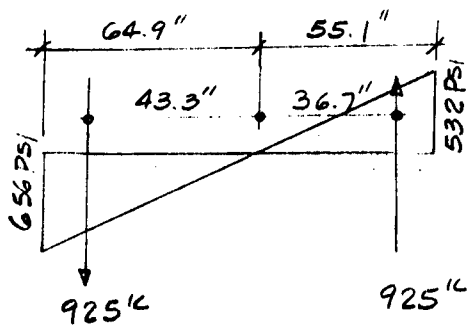
$-12 \times 12 \times (19)^2 \times 4 = -207,936$ } $-214,848$

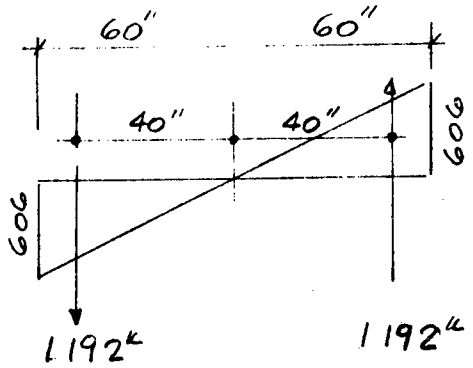
$305,985$ ft^4

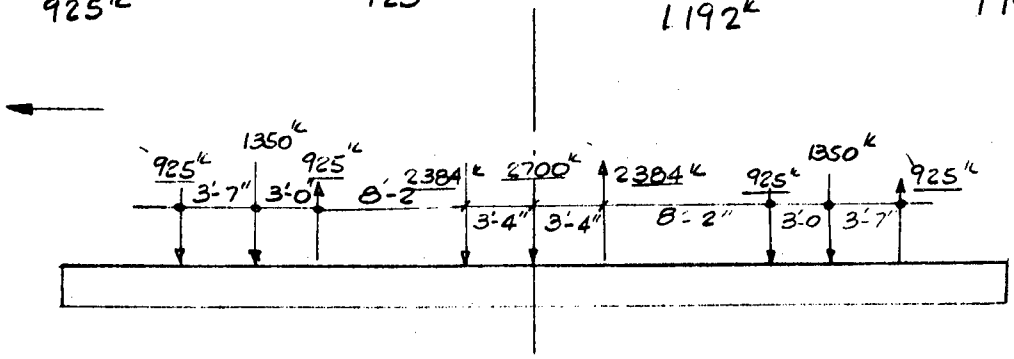
585

BY BL DATE ____ SUBJECT FOUNDATION STD. SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ FOUNDATION DESIGN JOB NO. ____

WIND STRESS DIST. ON MODULE







$P/A = 5400/1824 = 2961$ PSF

PeC/I

$= 925 \times 18.1 \times 25/305.99 = 1368$

$2384 \times 3.33 \times 25/305.99 = 649$

$2384 \times 3.33 \times 25/305.99 = 649$

$925 \times 18.1 \times 25/305.99 = 1368$

$-925 \times 11.5 \times 25/305.99 = -869$

$-925 \times 11.5 \times 25/305.99 = -869$

2296 PSF

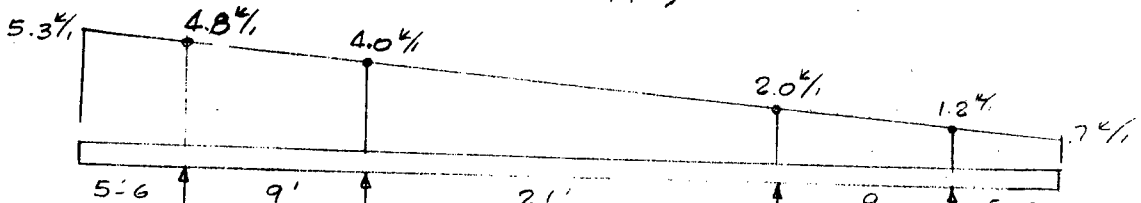
$P_{MIN.} = 2961 - 2296 = 665$ PSF

$P_{MAX.} = 2961 + 2296 = 5257$ PSF < 5333 PSF

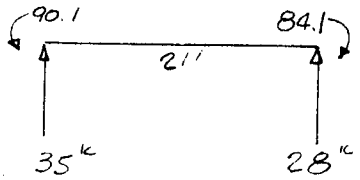
FAA-STD-017

BY BK DATE ____ SUBJECT FAA VLTOLOG STD
CHKD. BY ____ DATE ____ FOUNDATION DESIGN
SHEET NO. ____ OF ____
JOB NO. ____

D.L. + ½ LL + W.L. (MIDDLE STRIP)



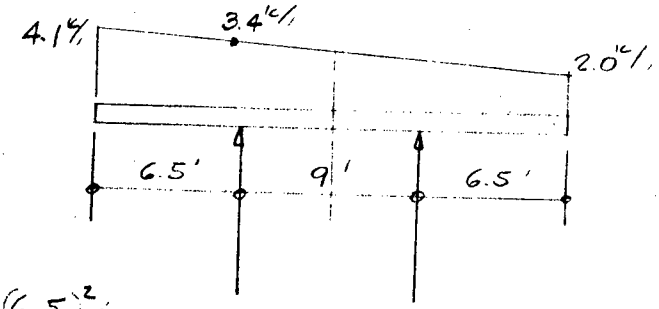
	1.0	.70	.30		.30	.70	1.0	
+77.6	-30.2	+29.2	-117.6		+102.9	-11.3	+13.3	+13.1
	-47.4	+61.8	+26.6		-27.6	-64.0	-2.8	
	+30.9	-23.7	-13.8		+13.3	-1.4	-32.0	
	-30.9	+26.2	+11.3		-3.6	-8.3	+32.0	
	+13.2	-15.4	-1.8		+5.6	+6.0	-4.2	
	-13.2	+12.0	+5.2		-6.5	-15.1	+4.2	
	77.6	90.1			84.1		13.1	



$+M = 28 \times 11 = 308$
$-2{,}11^3/2 = -121.0$
$-1.05 \times 11^2/6 = -21$
-84.1
-226.1

81.9 k

(EDGE STRIP)

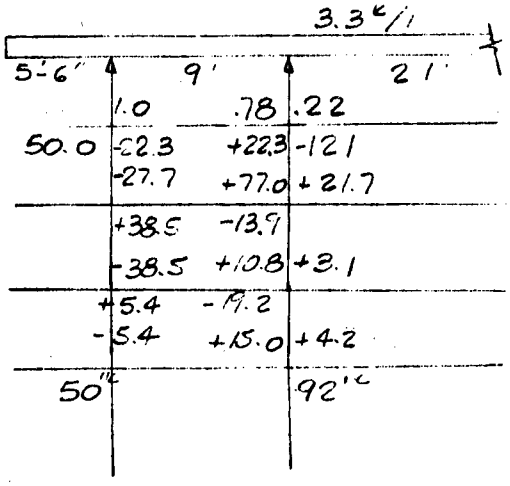


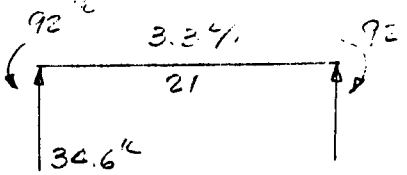
$M_{CONT.} = 3.4^k/' \times (6.5)^2/2 = 72^k$
$.7 \times (6.5)^2/3 = 9.9$
$\}$ 81.9 k

605

BY BC DATE ____ SUBJECT FAA NATIONAL STD FOUNDATION DESIGN SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

D.L. + L.L (MIDDLE STRIP)



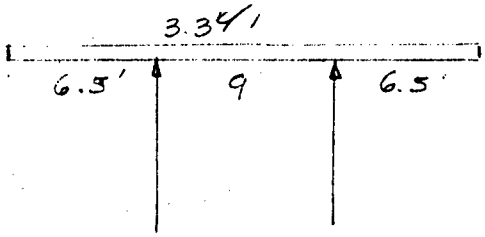


$+M = 34.6 \times 10.5/2 = 182'K$

$- \quad 92$

$+90'K$

(EDGE STRIP)



$M_{COLT} = 3.3 \times (6.5)^2/2 = 70'K$

BY BK DATE ____ SUBJECT FAA NATIONAL STD. SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ FOUNDATION DESIGN JOB NO. ____

MIN. A_s = 48 x 12 x .002 = 1.150"

A_s = 90/1.76 x 44 = 1.160"

A_s = 92/1.76 x 44 = 1.190"

USE #9@10" E.W. TOP & BOT.

CHECK SHEAR

b_o = 4 x 164 = 656 in

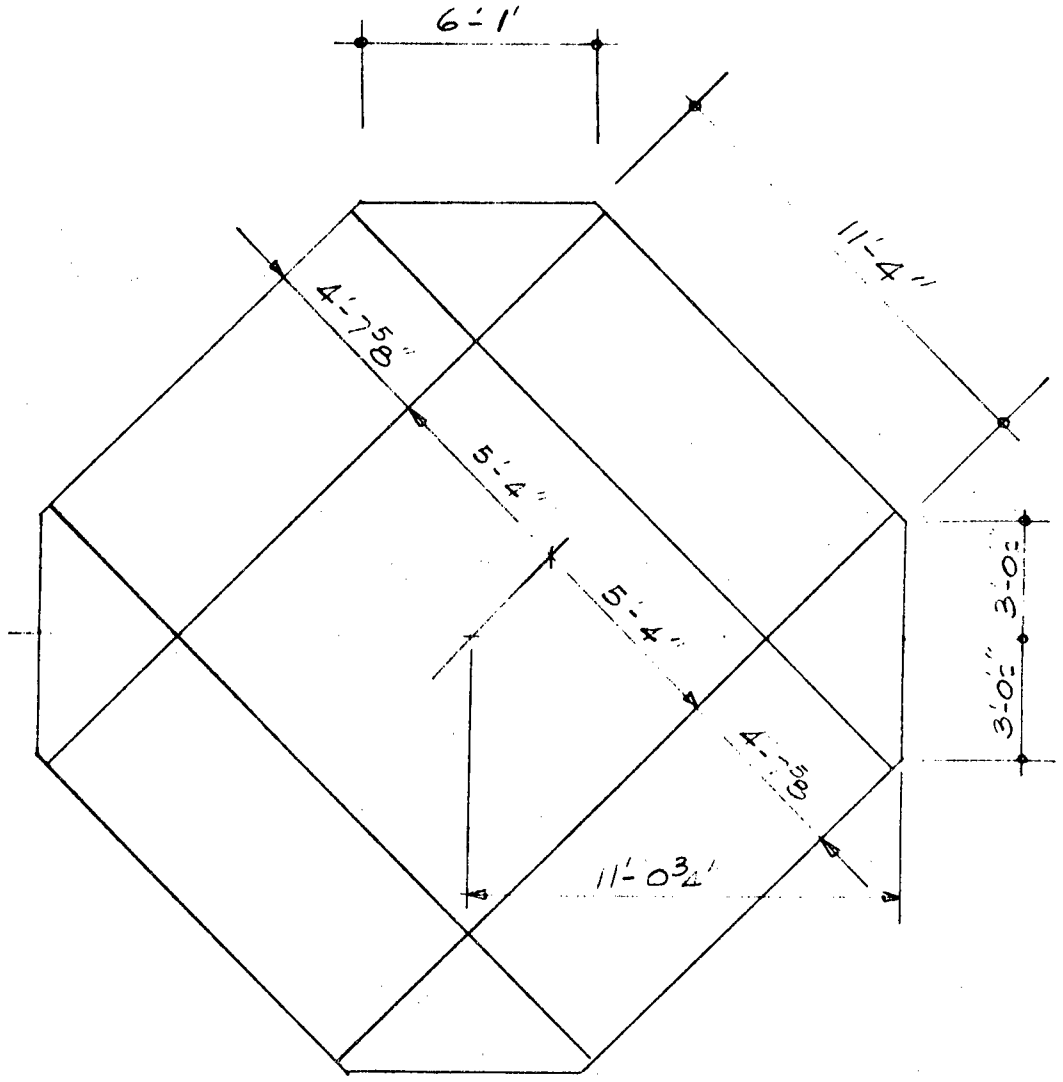
d = 44"

v = 1500/656 x 44 x 1000 = 52 PSI < 110 PSI OK

FAA-STD-017

BY BK DATE ____ SUBJECT NATIONAL STD. SHEET NO. ____ OF ____

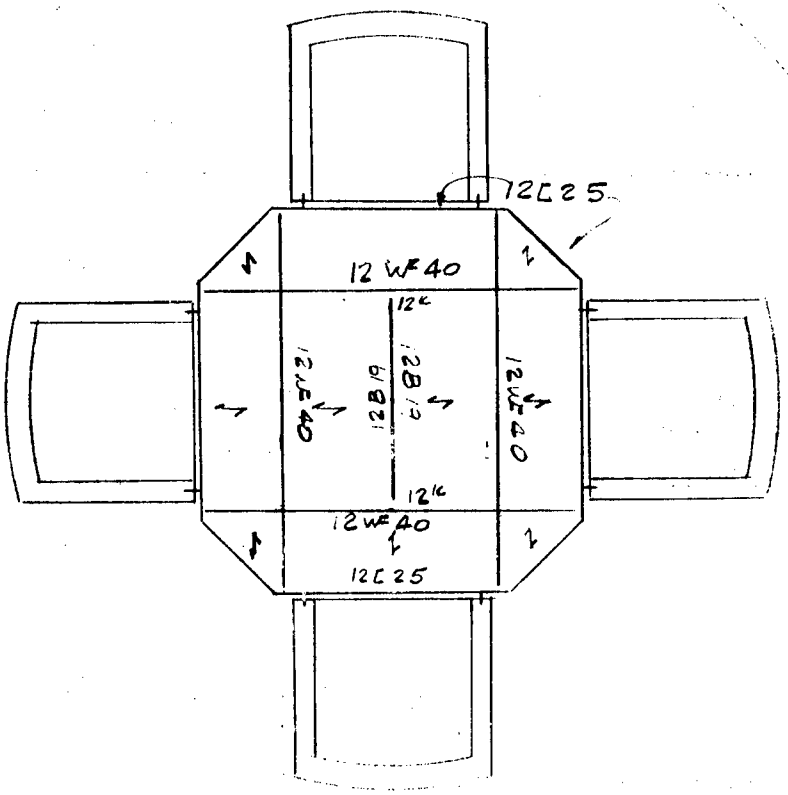
CHKD. BY ____ DATE ____ CABLE ACCESS FRAMING JOB NO. ____



FAA-STD-017

BY BK DATE ____ SUBJECT FAA TOWER SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ TYPICAL FRAMING JOB NO. ____



200#/L.F. TOTAL LOAD

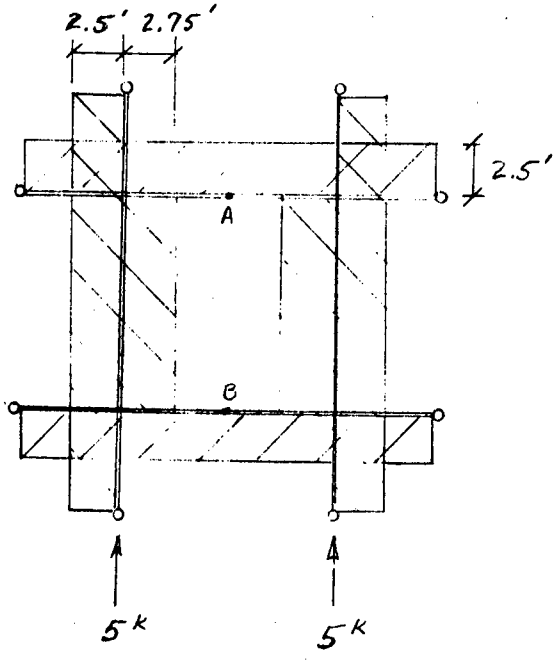
645

FAA-STD-017

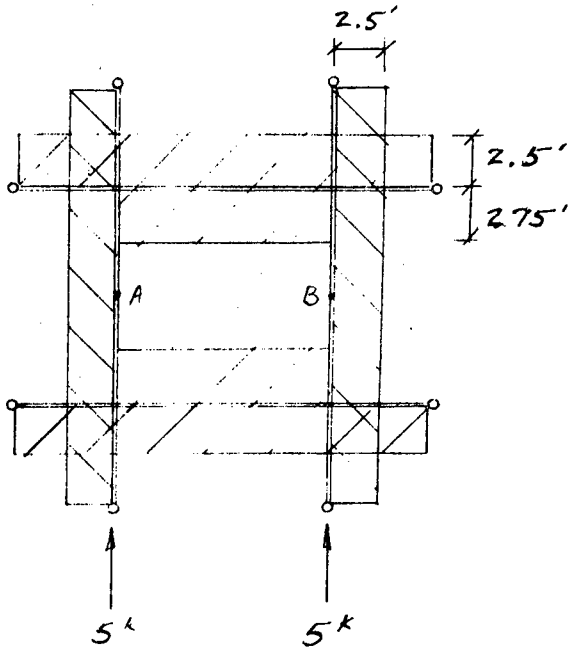
BY BLG DATE 7-9-20 SUBJECT FAA TOWER SHEET NO 2 OF
CHKD. BY DATE JOB NO 225

LOADING - 200 #/0' UNIFORM + 12 K CONC.
LOADS @ "A" & "B" + 5 K AXIAL L.D.

LOADING 1



LOADING 2



$(0.200\ \frac{K}{FT^2})(2.5\ FT)(\frac{1}{12}\ \frac{FT}{IN}) = 0.0417\ \frac{K}{IN}$

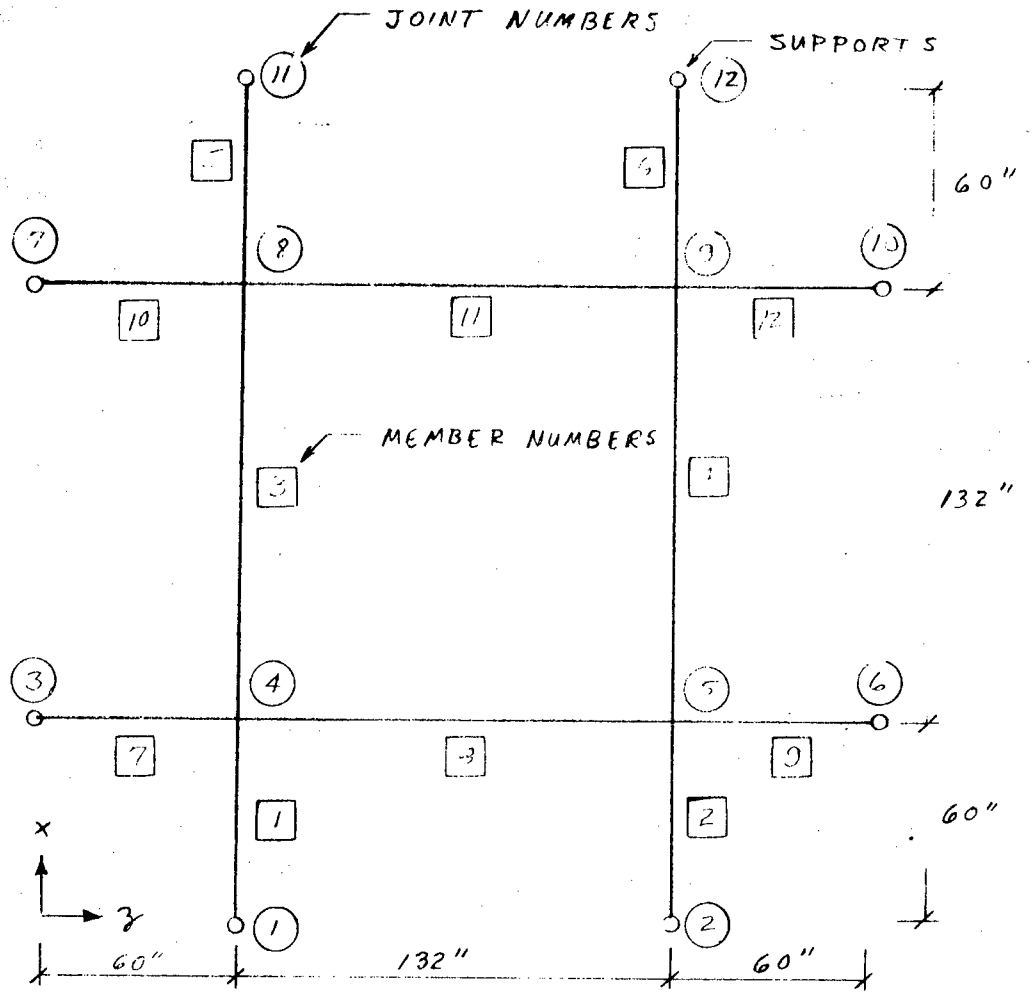
$(0.200\ \frac{K}{FT^2})(2.5 + 2.75\ FT)(\frac{1}{12}\ \frac{FT}{IN}) = 0.0875\ \frac{K}{IN}$

FAA-STD-017

BY RLG DATE 7-2-[illegible] SUBJECT [illegible] SHEET NO 1 OF [illegible]
CHKD. BY [illegible] DATE [illegible] JOB NO [illegible]

"STRESS" ANALYSIS OF TYPICAL [illegible]

JOINT COORDINATES AND MEMBER [illegible]



ALL MEMBERS 12WF 40 $I_z = 310.1$ $I_y = 44.1$ $I_x = K_T = 0.956$
$A_x = 11.77$ $A_y = A_z = 0$

655

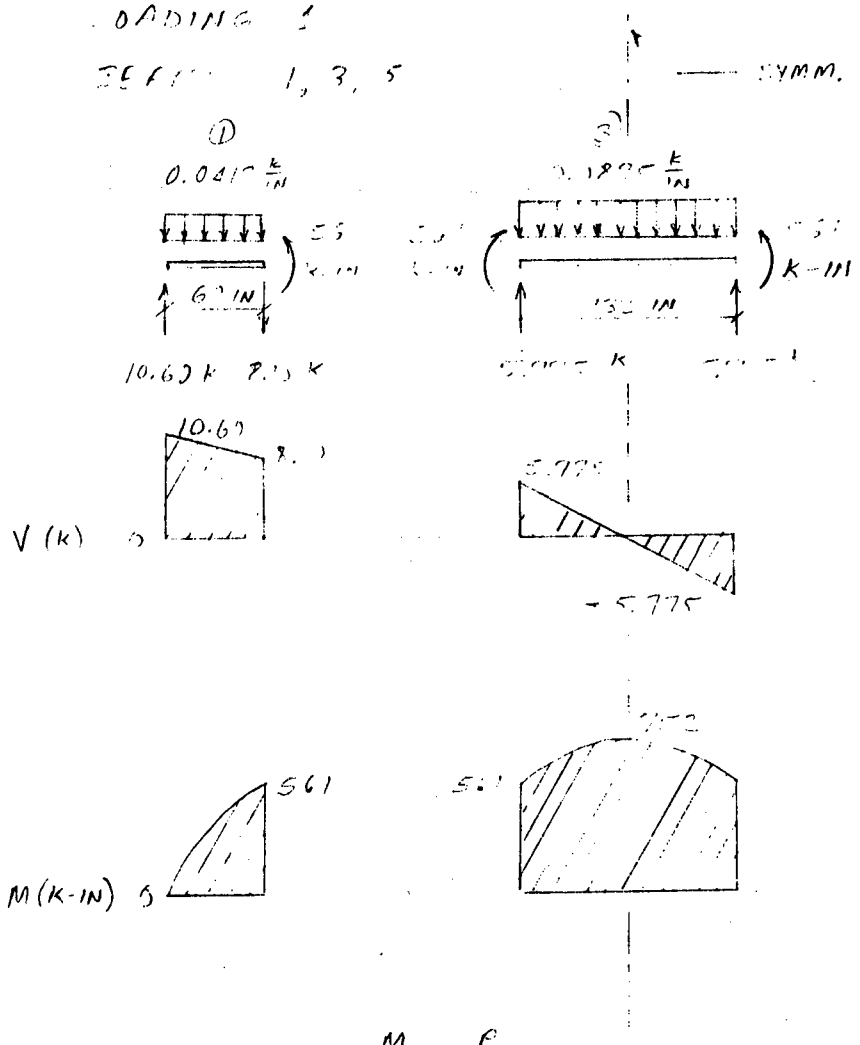
BY BLG DATE 7-9-20 SUBJECT FAA TOWER SHEET NO 3 OF
CHKD. BY DATE JOB NO 20-2

SHEAR AND MOMENT DIAGRAMS

LOADING 1

BEAM 1, 3, 5

MAX MAT AL DISPLACEMENT FOR LOADING 1 = 0.380 IN.



MAX STRESS = $\frac{M}{S} + \frac{P}{A}$

$= \frac{[illegible]}{51.9} + \frac{5}{11.77}$

$= 14.45 + 0.42$

$= 14.97$ KSI

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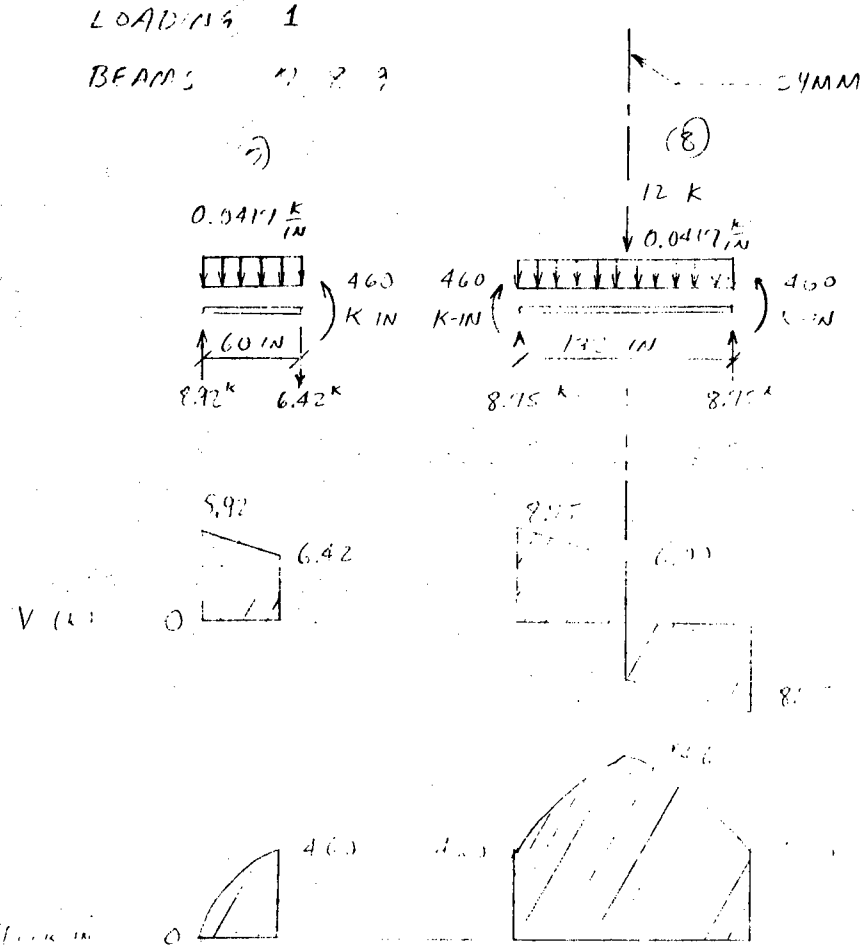
BY BLG DATE 7-9-20 SUBJECT FAA TOWER SHEET NO 4 OF
CHKD. BY DATE JOB NO 725

LOADING 1

BEAMS



$\frac{946}{51.9}$ = 18.25 KSI

BY BLG DATE 7.9.70 SUBJECT FAA TOWER SHEET NO. 5 OF
CHKD. BY DATE JOB NO. 725

LOADING 2 - MAX VERTICAL DISPLACEMENT = 0.380 IN.

BEAMS 1, 3, 7 - SAME AS BEAMS 7, 8, 9 OF LOADING 1
EXCEPT WITH AXIAL FORCE OF 5 K.

MAX STRESS = $\frac{M}{S} + \frac{F}{A}$

= 18.25 + 0.42

= 18.67 KSI

BEAMS 7, 8, 9 - SAME AS BEAMS 1, 2, 3 OF LOADING 1
EXCEPT WITH NO AXIAL FORCE

MAX STRESS = 14.45 KSI

COMPUTER

STRESS PROGRAM

PRINTOUT

70S

```
STRUCTURE FAA LANDING
TYPE SPACE FRAME
NUMBER OF JOINTS 12
NUMBER OF SUPPORTS 8
NUMBER OF MEMBERS 12
NUMBER OF LOADINGS 2
TABULATE ALL
JOINT COORDINATES
1 0.0 0.0 60.0 S
2 0.0 0.0 192.0 S
3 60.0 0.0 0.0 S
4 60.0 0.0 60.0
5 60.0 0.0 192.0
6 60.0 0.0 252.0 S
7 192.0 0.0 0.0 S
8 192.0 0.0 60.0
9 192.0 0.0 192.0
10 192.0 0.0 252.0 S
11 252.0 0.0 60.0 S
12 252.0 0.0 192.0 S
JOINT RELEASES
1 FORCE X  MOMENT X Y Z
2 FORCE X  MOMENT X Y Z
3  MOMENT X Y Z
6  MOMENT X Y Z
7  MOMENT X Y Z
10 MOMENT X Y Z
11 MOMENT X Y Z
12 MOMENT X Y Z
MEMBER INCIDENCES
1 1 4
2 2 5
3 4 8
4 5 9
5 8 11
6 9 12
7 3 4
8 4 5
9 5 6
10 7 8
11 8 9
12 9 10
MEMBER PROPERTIES PRISMATIC
1 THRU 12 AX 11.77 AY 0.0 AZ 0.0 IZ 310.1 IY 44.1 IX 0.956
CONSTANTS E 29000. ALL
LOADING 1
MEMBER LOADS
1 FORCE Y UNIFORM W -0.04167
2 FORCE Y UNIFORM W -0.04167
5 FORCE Y UNIFORM W -0.04167
6 FORCE Y UNIFORM W -0.04167
7 FORCE Y UNIFORM W -0.04167
```

```
 8 FORCE Y UNIFORM W -0.04167
 9 FORCE Y UNIFORM W -0.04167
 10 FORCE Y UNIFORM W -0.04167
 11 FORCE Y UNIFORM W -0.04167
 12 FORCE Y UNIFORM W -0.04167
 3 FORCE Y UNIFORM W -0.0875
 4 FORCE Y UNIFORM W -0.0875
 8 FORCE Y CONCENTRATED P -12.0 L 66.0
 11 FORCE Y CONCENTRATED P -12.0 L 66.0
JOINT LOADS
1 FORCE X 5.0
2 FORCE X 5.0
LOADING 2
MEMBER LOADS
 1 FORCE Y UNIFORM W -0.04167
 2 FORCE Y UNIFORM W -0.04167
 3 FORCE Y UNIFORM W -0.04167
 4 FORCE Y UNIFORM W -0.04167
 5 FORCE Y UNIFORM W -0.04167
 6 FORCE Y UNIFORM W -0.04167
 7 FORCE Y UNIFORM W -0.04167
 9 FORCE Y UNIFORM W -0.04167
10 FORCE Y UNIFORM W -0.04167
12 FORCE Y UNIFORM W -0.04167
8 FORCE Y UNIFORM W -0.0875
11 FORCE Y UNIFORM W -0.0875
3 FORCE Y CONCENTRATED P -12.0 L 66.0
4 FORCE Y CONCENTRATED P -12.0 L 66.0
JOINT LOADS
1 FORCE X 5.0
2 FORCE X 5.0
TRACE
SOLVE
PROBLEM CORRECTLY SPECIFIED, EXECUTION TO PROCEED.
```

STRUCTURE FAA LANDING

LOADING 1

MEMBER FORCES

MEMB	JOINT	AXIAL FORCE	SHEAR FORCE Y	SHEAR FORCE Z	TORSION MOMENT	MOMENT Y	MOMENT Z
1	1	4.999	10.603	-0.016	-0.00	0.00	0.00
1	4	-4.999	-8.103	0.016	0.00	0.99	561.20
2	2	4.999	10.603	0.016	0.00	0.00	0.00
2	5	-4.999	-8.103	-0.016	-0.00	-0.99	561.20
3	4	4.967	5.775	-0.008	0.00	0.67	-561.20
3	8	-4.967	5.774	0.008	0.00	0.43	561.20
4	5	4.967	5.775	0.008	-0.00	-0.67	-561.20
4	9	-4.967	5.774	-0.008	0.00	-0.43	561.20
5	8	4.955	-8.103	-0.003	0.00	0.21	-561.20
5	11	-4.955	10.603	0.003	0.00	0.00	-0.00
6	9	4.955	-8.103	0.003	0.00	-0.21	-561.20
6	12	-4.955	10.603	-0.003	0.00	0.00	0.00
7	3	0.004	8.922	0.032	0.00	-0.00	0.00
7	4	-0.004	-6.422	-0.032	-0.00	-1.97	460.32
8	4	-0.003	8.750	-0.000	-0.00	0.30	-460.32
8	5	0.003	8.750	0.000	0.00	-0.30	460.32
9	5	0.004	-6.421	-0.032	0.00	1.97	-460.32
9	6	-0.004	8.922	0.032	0.00	0.00	-0.00
10	7	0.002	8.922	0.011	-0.00	-0.00	0.00
10	8	-0.002	-6.422	-0.011	0.00	-0.71	460.32
11	8	-0.002	8.750	-0.000	0.00	0.06	-460.32
11	9	0.002	8.750	0.000	-0.00	-0.06	460.32
12	9	0.002	-6.421	-0.011	0.00	0.71	-460.32
12	10	-0.002	8.922	0.011	-0.00	-0.00	0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
4	0.000	-0.000	0.000	-0.00	0.00	-0.00
5	0.000	-0.000	0.000	-0.00	0.00	-0.00

8	0.000	-0.000	-0.000	-0.00	-0.00	0.00
9	-0.000	0.000	0.000	-0.00	0.00	0.00

REACTIONS, APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
1	4.999	10.603	-0.016	-0.00	0.00	0.00
2	4.999	10.603	0.016	0.00	0.00	0.00
3	-0.032	8.922	0.004	-0.00	-0.00	0.00
6	-0.032	8.922	-0.004	0.00	0.00	0.00
7	-0.011	8.922	0.002	-0.00	-0.00	-0.00
10	-0.011	8.922	-0.002	-0.00	-0.00	-0.00
11	-4.955	10.603	0.003	0.00	0.00	-0.00
12	-4.955	10.603	-0.003	0.00	0.00	0.00

FREE JOINT DISPLACEMENTS

JOINT	X DISPL	Y DISPL	Z DISPL	X-ROTAT	Y-ROTAT	Z-ROTAT
4	0.0027	-0.3804	-0.0000	0.0052	0.0000	-0.0050
5	0.0027	-0.3804	0.0000	-0.0052	-0.0000	-0.0050
8	0.0008	-0.3804	-0.0000	0.0052	0.0000	0.0050
9	0.0008	-0.3804	0.0000	-0.0052	-0.0000	0.0050

SUPPORT JOINT DISPLACEMENTS

JOINT	X DISPL	Y DISPL	Z DISPL	X-ROTAT	Y-ROTAT	Z-ROTAT
1	0.0036	0.0000	0.0000	0.0052	-0.0000	-0.0070
2	0.0036	0.0000	0.0000	-0.0052	0.0000	-0.0070
3	0.0000	0.0000	0.0000	0.0068	0.0000	-0.0050
6	0.0000	0.0000	0.0000	-0.0068	-0.0000	-0.0050
7	0.0000	0.0000	0.0000	0.0068	0.0000	0.0050
10	0.0000	0.0000	0.0000	-0.0068	-0.0000	0.0050
11	0.0000	0.0000	0.0000	0.0052	-0.0000	0.0070
12	0.0000	0.0000	0.0000	-0.0052	0.0000	0.0070

STRUCTURE FAA LANDING

LOADING 2

MEMBER FORCES

MEMB	JOINT	AXIAL FORCE	SHEAR FORCE Y	SHEAR FORCE Z	TORSION MOMENT	MOMENT Y	MOMENT Z
1	1	4.999	8.922	-0.016	-0.00	0.00	0.00
1	4	-4.999	-6.421	0.016	0.00	0.99	460.32
2	2	4.999	8.922	0.016	0.00	0.00	0.00
2	5	-4.999	-6.421	-0.016	-0.00	-0.99	460.32
3	4	4.967	8.750	-0.008	0.00	0.67	-460.32
3	8	-4.967	8.750	0.008	-0.00	0.43	460.32
4	5	4.967	8.750	0.008	-0.00	-0.67	-460.32
4	9	-4.967	8.750	-0.008	0.00	-0.43	460.32
5	8	4.955	-6.421	-0.003	0.00	0.21	-460.32
5	11	-4.955	8.922	0.003	0.00	0.00	-0.00
6	9	4.955	-6.421	0.003	0.00	-0.21	-460.32
6	12	-4.955	8.922	-0.003	0.00	0.00	0.00
7	3	0.004	10.603	0.032	0.00	-0.00	0.00
7	4	-0.004	-8.103	-0.032	-0.00	-1.97	561.20
8	4	-0.003	5.774	-0.000	-0.00	0.30	-561.20
8	5	0.003	5.775	0.000	0.00	-0.30	561.20
9	5	0.004	-8.103	-0.032	-0.00	1.97	-561.20
9	6	-0.004	10.603	0.032	0.00	0.00	0.00
10	7	0.002	10.603	0.011	-0.00	-0.00	0.00
10	8	-0.002	-8.103	-0.011	0.00	-0.71	561.20
11	8	-0.002	5.774	-0.000	0.00	0.06	-561.20
11	9	0.002	5.775	0.000	-0.00	-0.06	561.20
12	9	0.002	-8.103	-0.011	0.00	0.71	-561.20
12	10	-0.002	10.603	0.011	-0.00	-0.00	-0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
4	0.000	-0.000	0.000	-0.00	0.00	-0.00
5	0.000	0.000	0.000	-0.00	0.00	-0.00

8	0.000	-0.000	-0.000	-0.00	-0.00	0.00
9	-0.000	-0.000	0.000	0.00	0.00	0.00

REACTIONS, APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
1	4.999	8.922	-0.016	-0.00	0.00	0.00
2	4.999	8.922	0.016	0.00	0.00	0.00
3	-0.032	10.603	0.004	-0.00	-0.00	0.00
6	-0.032	10.603	-0.004	-0.00	0.00	0.00
7	-0.011	10.603	0.002	-0.00	-0.00	-0.00
10	-0.011	10.603	-0.002	0.00	-0.00	-0.00
11	-4.955	8.922	0.003	0.00	0.00	-0.00
12	-4.955	8.922	-0.003	0.00	0.00	0.00

FREE JOINT DISPLACEMENTS

JOINT	X DISPL	Y DISPL	Z DISPL	X-ROTAT	Y-ROTAT	Z-ROTAT
4	0.0027	-0.3804	-0.0000	0.0050	0.0000	-0.0052
5	0.0027	-0.3804	0.0000	-0.0050	-0.0000	-0.0052
8	0.0008	-0.3804	-0.0000	0.0050	0.0000	0.0052
9	0.0008	-0.3804	0.0000	-0.0050	-0.0000	0.0052

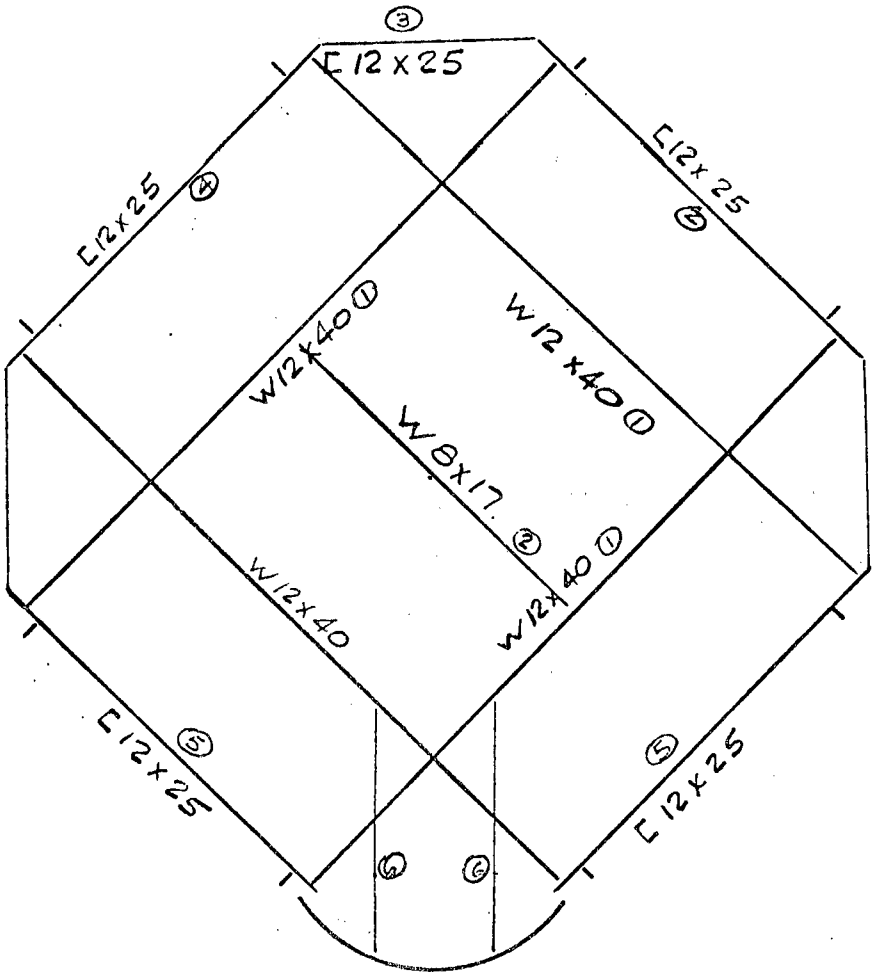
SUPPORT JOINT DISPLACEMENTS

JOINT	X DISPL	Y DISPL	Z DISPL	X-ROTAT	Y-ROTAT	Z-ROTAT
1	0.0036	0.0000	0.0000	0.0050	-0.0000	-0.0068
2	0.0036	0.0000	0.0000	-0.0050	0.0000	-0.0068
3	0.0000	0.0000	0.0000	0.0070	0.0000	-0.0052
6	0.0000	0.0000	0.0000	-0.0070	-0.0000	-0.0052
7	0.0000	0.0000	0.0000	0.0070	0.0000	0.0052
10	0.0000	0.0000	0.0000	-0.0070	-0.0000	0.0052
11	0.0000	0.0000	0.0000	0.0050	-0.0000	0.0068
12	0.0000	0.0000	0.0000	-0.0050	0.0000	0.0068

FAA-STD-017

BY BK DATE 1/10/72 SUBJECT FAA NATL STD SHEET NO. 1 OF

CHKD. BY DATE SUB JUNCTION LEVEL JOB NO.



SUB JUNCTION LEVEL

BY BK DATE ____ SUBJECT FAA NATIONAL STD. SHEET NO. 2 OF ____
CHKD. BY ____ DATE ____ SUB JUNCTION LEVEL JOB NO. ____

SLAB & DECK 60#/0' } 65 #/0' D.L.
SOFFIT 5 }
150 L.L
215 #/0' T.L.

CONNECTIONS

$P = \frac{.215\ (20 \times 20. - 4 \times 4/2 \times 3)}{8} = 10.6^K$ (USE 24^K MIN REACTION @ EA. CONN)

BM - 1

USE W 12 X 40 (SEE DESIGN OF TYPICAL LANDING)

BM - 2

W = .215 X 3.8 = .82 K/1 } .85 K/1
BM .03 }

M = .85 X (10.7)²/8 = 12.2 IK
V = .85 X 10.7/2 = 4.6 K

USE W 8 X 17
OR W 12 X 19

BM - 3

W = 2 @ .215 = .43 K/1
WALL = .30
BM = .03
.76 K/1 USE .8 K/1

M = .8 X (6)²/8 = 3.6 IK
V = .8 X 6/2 = 2.4 K

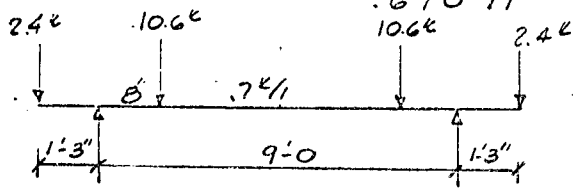
USE C 12 X 25
(SAME AS TYP. PLATFORM)

FAA-STD-017

BY BK DATE ____ SUBJECT FAA. NATIONAL STD SHEET NO. 3 OF ____
CHKD. BY ____ DATE ____ SUB JUNCTION LEVEL JOB NO. ____

BM - 4

$w = 3 \times .215 = .645$ K/I
$BM = .025$
$.670$ K/I



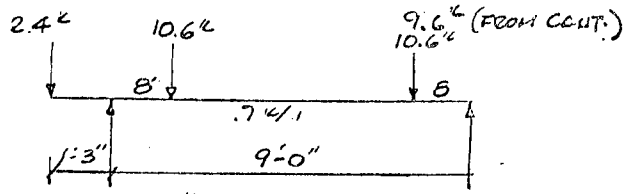
10.6
2.4
4.7
17.7 K

$M_{CANT.} = 2.4 \times 1.25 = 3.0$
$.7 \times (1.25)^2/8 = .14$
3.14'

$+M = 17.7 \times 4.5' = 80$ 'K
$-2.4 \times 5.75' = -13.8$
$-10.6 \times 3.82 = -40.5$ } 65.9
$-.7 \times (5.75)^2/2 = -11.6$
14.1 'K

USE [12 X 25
(SAME AS TYP. PLATFORM)

BM - 5



10.6K	10.6K
.7	8.9
3.2	3.2
2.6	-.2
2.2	-.1
19.3 K	22.4

$M_{CANT.}$ (SEE BM 4 ABOVE)

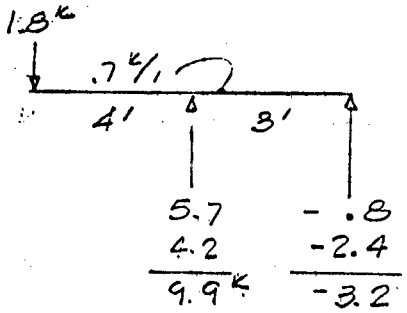
$+M = 22.4 \text{ @ } 3.15 = 70.5$
$-20.2 \times 2.48 = -50.0$
$-.7 \text{ @ } (3.15)^2/2 = -3.5$
17.0

USE [12 X 25

BY BK DATE ____ SUBJECT FAA NATIONAL STD. SHEET NO 4 OF ____
CHKD. BY ____ DATE ____ SUB JUNCTION LEVEL JOB NO. ____

BM-6

$W = 3 \times .215 = .645$
$BM = .020$
$\} .665^{K/'}$



$M_{COUT} = 1.8 \times 4 = 7.2$
$.7 \times (4)^2/2 = 5.6$
$12.8^{'K}$

USE W 6X12

$$\Delta = \frac{1{,}800 \times 4^3 \,(2\times4\times3 + 3\times4\times4 - 4\times4)}{6\times29\times10^6\times21.7} \times 1728 = .18$$

$$\frac{665 \times 4 \,(4\times16\times3 - 27 + 6\times16\times4 - 4\times4\times16 + 64)}{24 \times 29\times10^6\times21.7} \times 1728 = .11$$

Δ_{TOTAL} $.29''$

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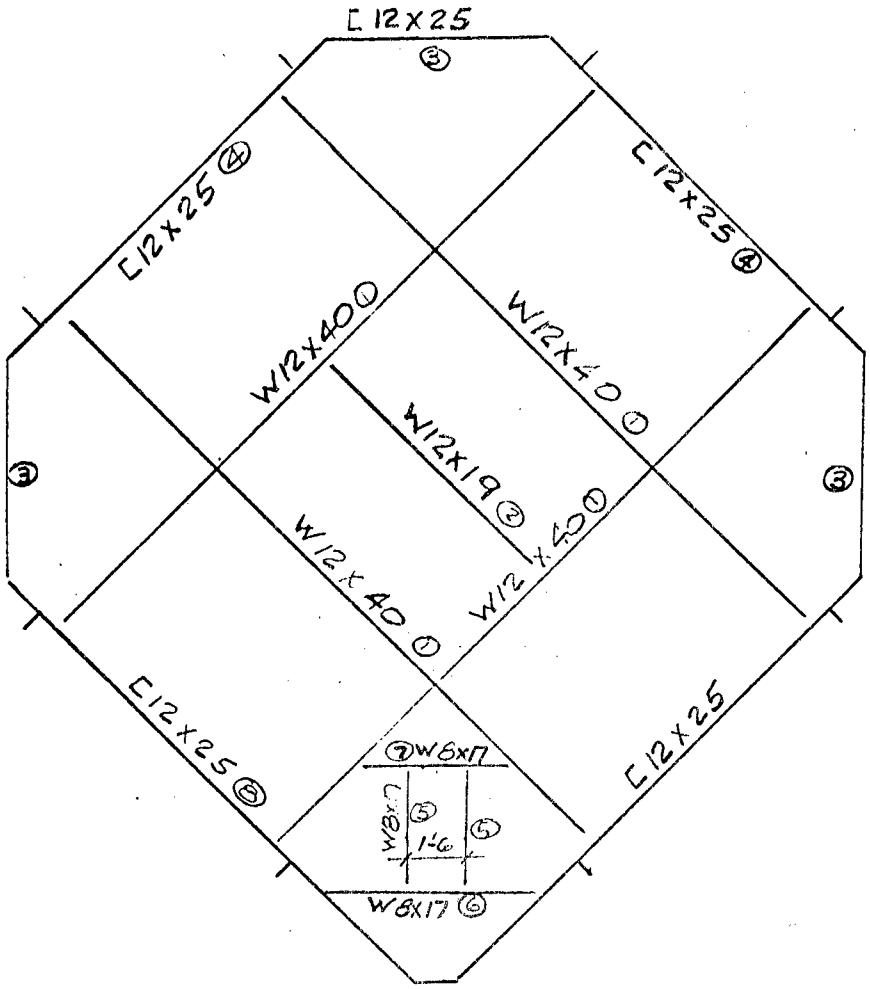
BY BK DATE ____ SUBJECT F.A.A. NATIONAL STD SHEET NO 5 OF ____
CHKD. BY ____ DATE ____ JOB NO. ____
JUNCTION LEVEL



BY B.K. DATE ____ SUBJECT F.A.A. NATIONAL STD. SHEET NO. 6 OF ____
CHKD. BY ____ DATE ____ JUNCTION LEVEL JOB NO. ____

SLAB & DECK 60#/0' } 65 #/0' D.L.
SOFFIT 5 }
150 L.L.
215 #/0' T.L.

BM - 1 USE W 12X40 (SEE DESIGN OF TYP. LANDING)

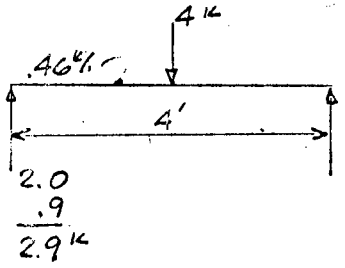
BM - 2 USE W 12X19 (SEE SUBJUNCTION LEVEL)

BM - 3 USE C 12X25 (SEE SUBJUNCTION LEVEL)

BM - 4 USE C 12X25 (SEE SUBJUNCTION LEVEL)

BM - 5

WT OF PIPE & STAIR = .15 X 20 = 3K D.L.
1K L.L } 4K (USE 5K MIN.)



w = 2 x .215 = .43 K/'
BM = .03
.46 K/'

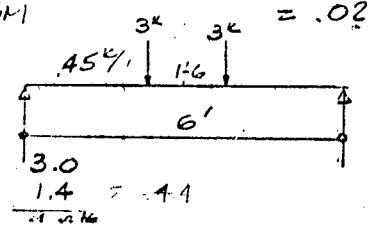
M = .5 K (4)²/8 = 1.0
4K 4/4 = 4.0 } 5.0'K

USE W 8X17

V = 2.5 + 1.4 = 2.9 K

3M-6

w = 3K .215 = .43 K/'
BM = .02 } .45 K/'



M = -.45 x (3)²/2 = - 2.02
- 3.0 x (.75) = - 2.25
4.4 x 3 = +13.20 } 8.9K

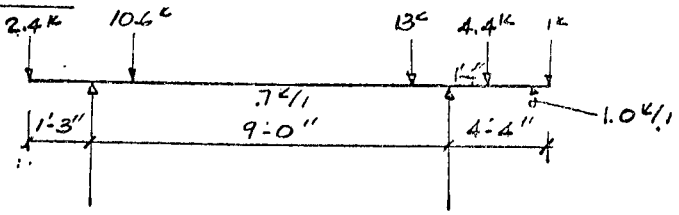
USE W 8X17

FAA-STD-017

BY BK DATE ____ SUBJECT FAA NATIONAL STD. SHEET NO 1 OF ____
CHKD. BY ____ DATE ____ JOB NO ____
JUNCTION LEVEL

BM-7 USE W8X17 (SIMILAR TO BM-6)

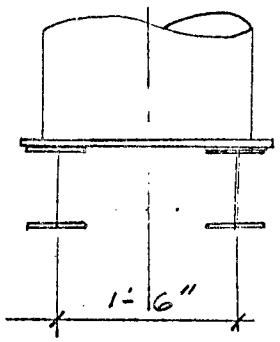
BM-8



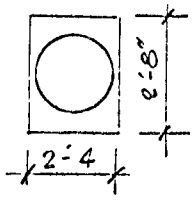
CANT. MOMENT CRITICAL.
SEE BM-5 @ SUB JUNCTION LEVEL

-M =	1X 4.3 =	4.3
	1X (4.3)²/2 =	9.2
	4.4 K/1.3 =	5.7
		19.2 IK

USE C 12 X 25



BASE R FOR CIRCULAR STAIR



P = 8K

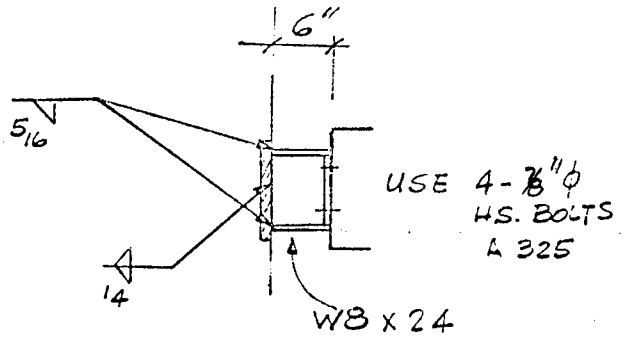
$f = 8000/24 \times 24 = 14$ PSI
$M = 14K(18)^2/8 = 568''^{\#}$
$S_m = 568''^{\#}/20{,}000\#/\square'' = .0284 in^3/in$
$1/2''$ R $S_m = 0416\ in^3/in$ OK

BASE R:
28 X 1/2 X 2'-8

BY BK DATE ____ SUBJECT FAA NAT'L STD. SHEET NO 8 OF ____
CHKD. BY ____ DATE ____ JUNCTION LEVEL JOB NO. ____

CONNECTION TO MODULE

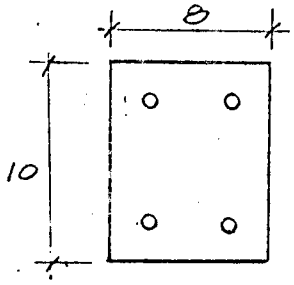
$P = 20^K$
$e = 6''$
$Pe = 120''^K$
$T = C = 120/8 = 15^K$
USE $5/16''$ WELD
$\ell_{rqd} = 15/4 = 3.75''$ USE 6"T≠B FLG ($5/16''$ WELD)



WEB CONN

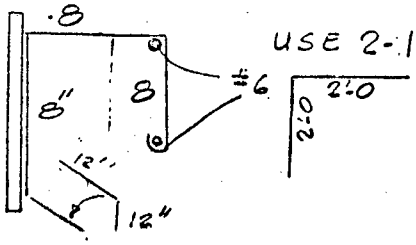
$\ell = 6''$
1/4 WELD
$P = 20^K$
$\ell_{rqD} = 20/3.2 = 6.25''$
USE 6" EA SIDE WEB = 12" TOTAL (1/4" WELD)

WELD PL 10 x 8 x 1/2



$T = 15^K$
$V = 20^K$
$N = 20/13.3 = 1.5$ USE 4 MIN

STRAP $15/20 = .75^D$"
USE 2-1 x 1/2" STRAP (1D")



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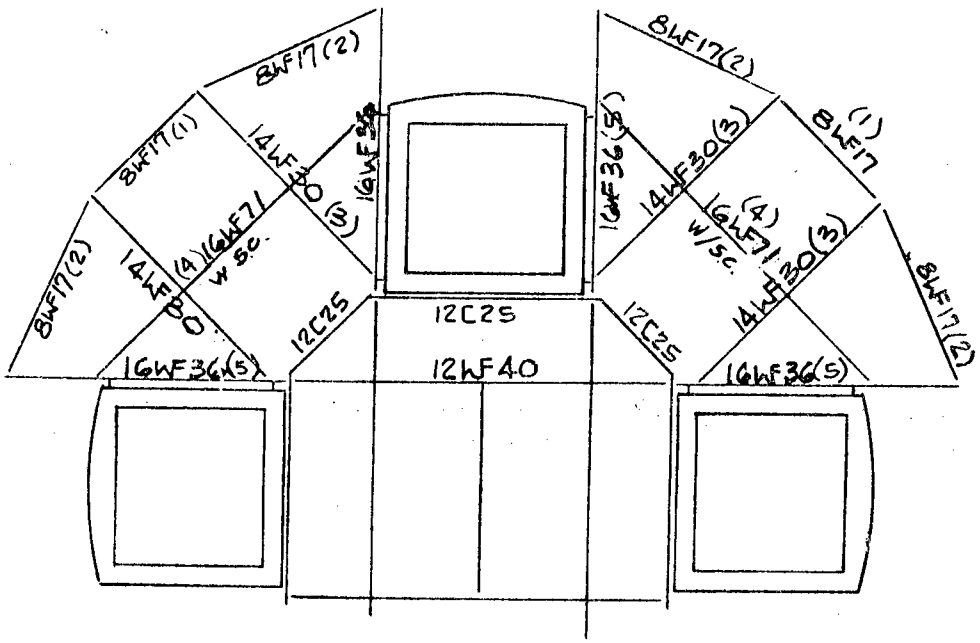
BY_____DATE_____ SUBJECT MICRO WAVE FLOOR SHEET NO_____OF_____

CHKD. BY_____DATE_____ JOB NO._____



MICROWAVE LEVEL FRAMING

BY BK DATE ____ SUBJECT FAA TOWER SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ MICROWAVE LEVEL JOB NO. ____

SLAB & DECK

60 D.L.
150 L.L.
210 #/ft T.L.

BM-1

W = 3.5 X 60 = 210
WALL 20 X 15 = 300
BM & MISC = 20
} 530 #/ft D.L.

3.5 X 150 = 525 #/ft L.L.
1055 #/ft

ℓ = 9'-0" ±
V = 4.5 x 1.06 #/ft = 4.8 K
M = 1.06 x (9)²/8 = 10.7 'K

USE 8 WF 17

BM-2

W = 3.0 X 60 = 180
WALL = 300
BM & MISC = 20
} 500 #/ft D.L.

3.0 X 150 450 L.L.
910 #/ft

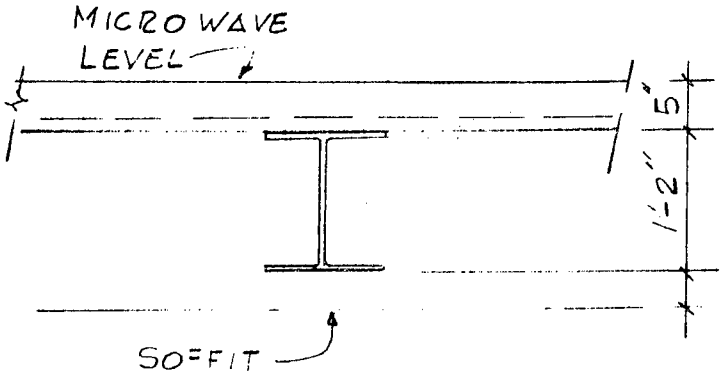
ℓ = 9'-6" ±
V = 9.5/2 X .91 = 4.3K
M = .91 x (9.5)²/8 = 10.3 'K

USE 8 WF 17

FAA-STD-017

BY BK DATE ____ SUBJECT F.A.L. TOWER SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____



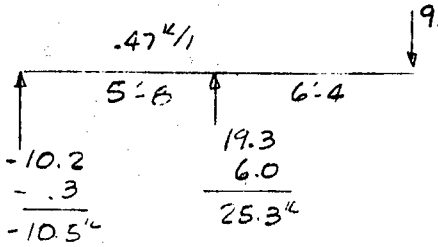
FAA-STD-017

BY BK DATE ____ SUBJECT FAA TOWER SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ MICRO WAVE LEVEL JOB NO. ____

BM 3

w_{DL} = 60 x 2 = 120
BM + HAULCL = 50
170 #/' D.L.
150 x 2 300 L.L.
470 #/' T.L.

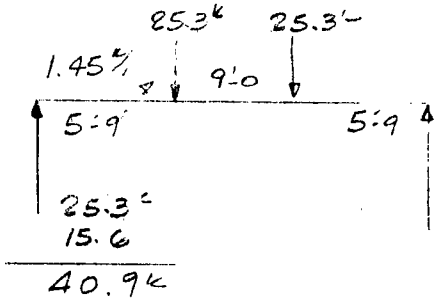


M_{CLCT} = 9.1 x 6.33 = 57.5
.47 x (6.33)²/2 = 9.5
67.0 'K

14 WF 30

BM 4

w_{DL} = 6.5 x 60 = 390
BM + HAULCL = 80
470 #/' DL
w_{LL} = 6.5 x 150 = 975 #/' LL
1445 #/' TL



M = 40.9 x 10.25 = 420 'K
-1.45 x (10.25)²/2 = -76
-25.3 x 4.5 = -114
-190
230 'K

16WF 71 COMPOSITE
(48) W/ SLAB CONN.

BM-5 L = 8' ±

w_{DL} = 5 x 80 = 400
BM + HAULCL = 100
500 #/' D.L
5 x 150 = 750 LL
1250 #/'

$M = 1.25 \times 8^2/8 = 10$ 'K

14 B 17.2

(DISTANCE ...)

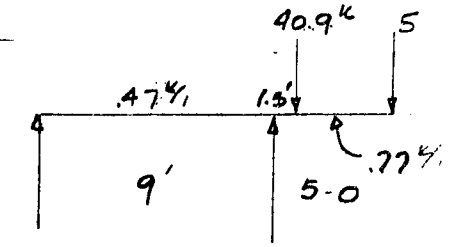
805

FAA-STD-017

BY BK DATE ____ SUBJECT FLL TOWER SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

BM-5



- 1.0
- 2.8
- 8.0
- 11.8K

5.8
7.8
48.9
62.5K

a^2 = 30.3 ft²
ℓ = 9'
ℓ^3 = 729 ft³

BM = .05
W = .21 b 2 = .42 K/'
WALL .30
.77K/'

M_{CONT} = 5K 5.0 = 25.0
40.9 x 1.5 = 61.4
.77K (5.0²/2) = 9.6
96.0

USE 16 WF 36

$$\Delta_1 = \frac{770 \times 5.5\ (1728)}{24 \times 29 \times 10^6 \times 446}\ (21.2 \times 9 + 181.8 \times 5.5 + 22 \times 30.3 + 166.7)$$

(1091, 1000, 667, 2925)

= .06

$$\Delta_2 = \frac{5000 \times 5.5\ (144)}{6 \times 29 \times 10^6 \times 446}\ (11 \times 9 + 3 \times 30.3 + 30.3)$$

(99)

= .01

$$\Delta_3 = \frac{470 \times 729 \times 5.5\ (1728)}{24 \times 29 \times 10^6 \times 446}$$

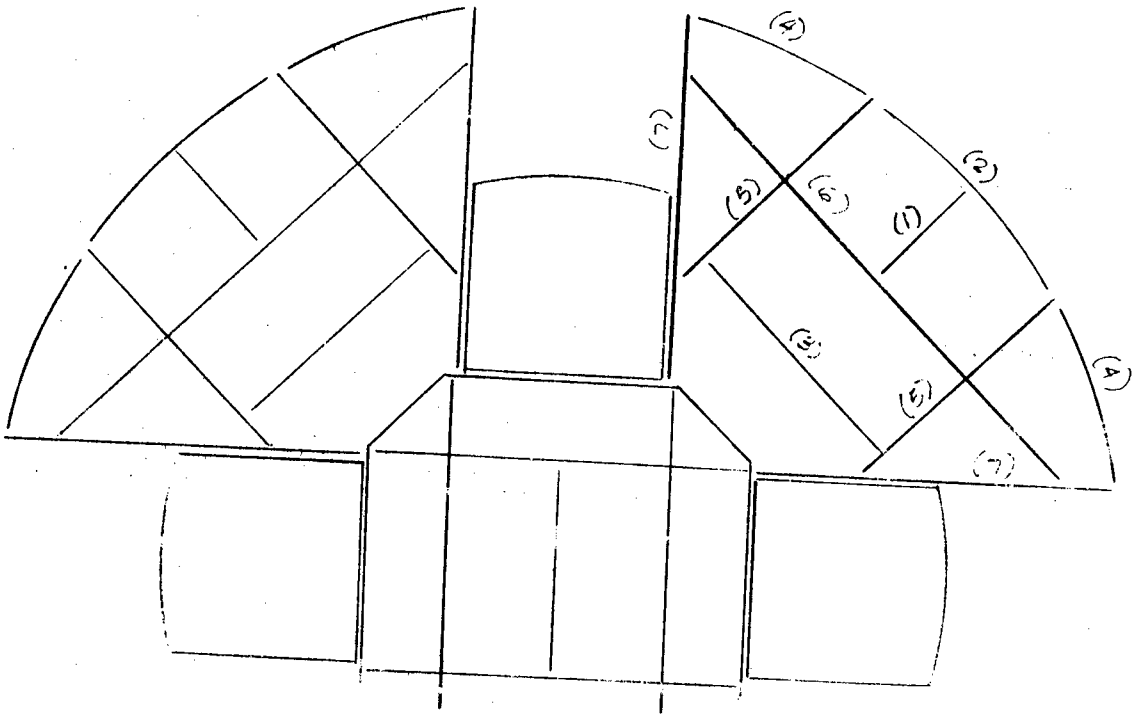
= .01

FAA-STD-017

BY_____DATE_____ SUBJECT MICROWAVE ROOF

CHKD. BY_____DATE_____ SHEET NO._____OF_____

JOB NO._____



MICROWAVE ROOF (JUNCTION LEVEL)
FRAMING PLAN

FAA-STD-017

BY BK DATE 10/9/ SUBJECT MICROWAVE ROOF SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO ____

DECK + FILL 60 #/□'
ROOFING 6
INSUG 2
MISC. 2
70 #/□' D.L.
50 L.L.
120 #/□' T.L.

BM-1

$\ell = 7'-0''$

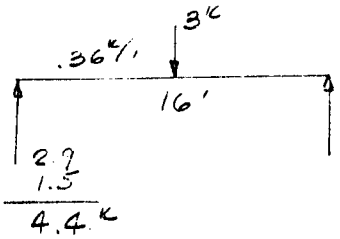
$w = .12 \times 7 = .84^{k}/_{'}$
BM = .02
$.86^{k}/_{'}$
$V = .86 \times 7/2 = 3.0^{k}$
$M = .86 \times (7)^{2}/8 = 5.3'^{k}$

BWF 17

BM-2

$\ell = 16'$

$w = 2.0 \times .20 = .24$
FACIA = .10
BM = .02
$.36^{k}/_{'}$



$M = .36 \times (16)^{2}/8 = 11.5'^{k}$
$3 \times 16/4 = 12.0$
$23.5'^{k}$

BWF 17

BM-3

$\ell = 14'$

$w = .12 \times 6 = .72$
BM = .02
$.74^{k}/_{'}$
$V = .74 \times 14/2 = 5.2^{k}$
$M = .74 \times (14)^{2}/8 = 18.2'^{k}$

835

BWF 17

FAA-STD-017

BY BK DATE ____ SUBJECT MICROWAVE ROOF SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO ____

BM-4

$\ell = 12'$

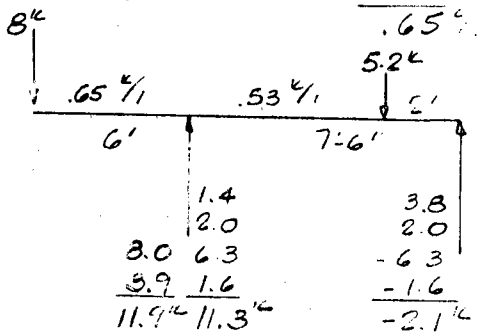
$w = 3 \times .120 = .36$
FACIA $= .10$
BM $= .02$
$.48^{k}/_{'}$

$V = .48 \times 12/2 = 2.9^{k}$
$M = .48 \times (12)^2/8 = 8.7'^{k}$

8 wk 17

BM-5

$w = 5 \times .120 = .60$
BM $= .05$
$.65^{k}/_{'}$

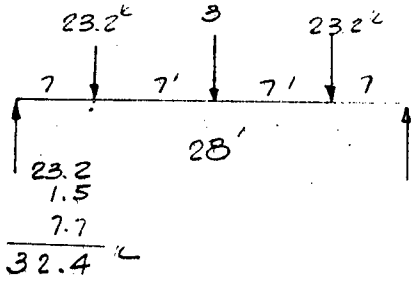


$w = 4 \times .120 = .48$
BM $= .05$
$.53^{k}/_{'}$

$M_{CLL} = 8/6 = 48$
$.65 \times (6)^2/2 = 11.7$
59.7

12 wk 27

BM-6



$w = 4 \times .120 = .48$
BM $= .07$
$.55^{k}/_{'}$

$M = 32.4 \times 14 = 453'^{k}$
$-23.2 \times 7 = -161$
$-.55 \times (14)^2/2 = -54$
$238'^{k}$

21 wk 62

845

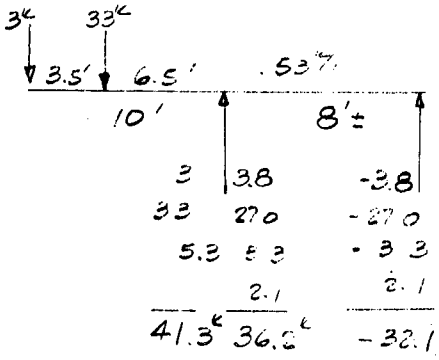
FAA-STD-017

BY BK DATE ____ SUBJECT Microwave 200F SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

BM-7

$W = 31.120 = .36^k$
$BM = .07$
$FOOT = .10$
$\} .53^k$



M_{CL} $3^k \times 10 = 30$
$33^k \times 6.5 = 214$
$.53^k \times 10^2/12 = 27$
$271'^k$

21×68

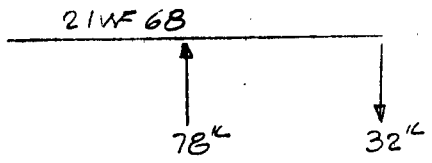
855

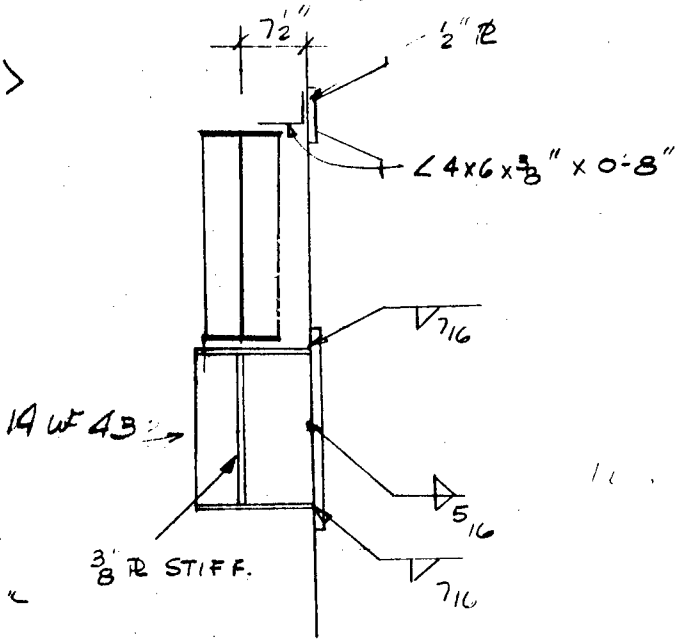
FAA-STD-017

BY BK DATE ____ SUBJECT FAA TOWER CONNECTIONS SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

JUNCTION LEVEL (MICROWAVE ROOF)

(21WF68 TO MODULE)





$P_e = 7.5 \times 80 = 600^K$

$T = C = 600/14 = 43.0^K$

USE 7/16" WELD

$\ell_{req} = 43.0/5.6 = 7.7"$ USE 8" T & B FLANGE 7/16" WELD

WEB CONN.

$\ell = 12"$

5/16 WELD

$P = 4.0^K/"$

$\ell = 80/4 = 20"$

USE 12" EL SIDE

WELD PL

$T = C = 43^K$

$P = 80^K$

USE ¾" ϕ x 5' LG SHEAR STUDS

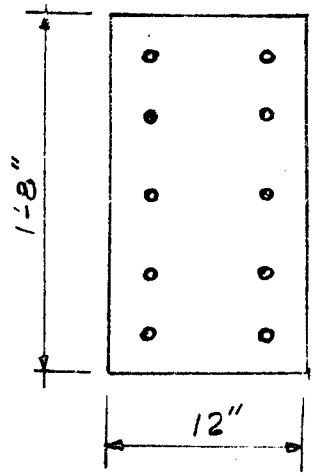
$N = 80/13.3 = 6$ USE 10

865

FAA-STD-017

BY BK DATE ____ SUBJECT FAA TOWER SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____
CONNECTION

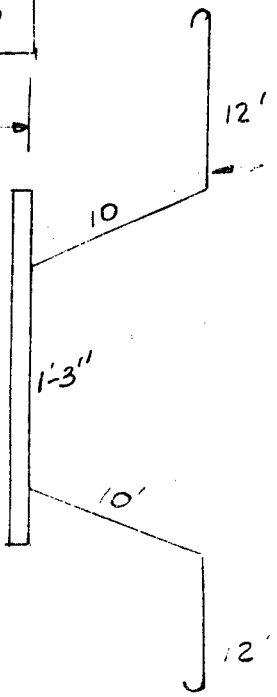
WELD PL USE 12' x 5/8 x 1'-8"



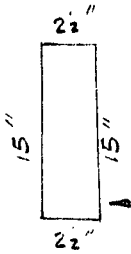
T = 40 K/20 = 2.0 D FOR STRAP

USE 5/8 x 2 1/2 STRAP (2)

(TYPE 3 PL)



2 - 5/8, 2 1/2 STRAPS
Δ = 3.12 D" > 2.0 D" (EQ)
ASSUME 20 K/STRAP (TENSION)



WELD PATTERN

3/8" WELD
a = 1.0
k = 0
C1 = .305

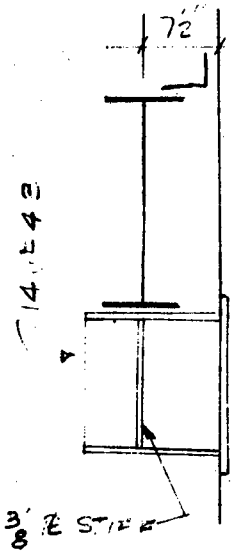
P = .305 x .86 x 6 x 15 = 23.6 K OK

(LOOK P FROM TOP & BOT WELD NOT FIGURED)

875

BY BK DATE ____ SUBJECT FAA TOWER CONNECTIONS SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

JUNCTION LEVEL (MICROWAVE ROOF)



$P_e = 7.5 \times 40 = 300^K$

$T = C = 300/14 = 21.4^K$

USE 7/16" WELD

$\ell_{REQD} = 21.4/5.6 = 3.82$

USE 6" T & B ELG.

WEB CONN.

$\ell = 10"$

$P = 3.2^K/"$

$\ell = 40/3.2 = 12.5$

USE 10" EL SIDE

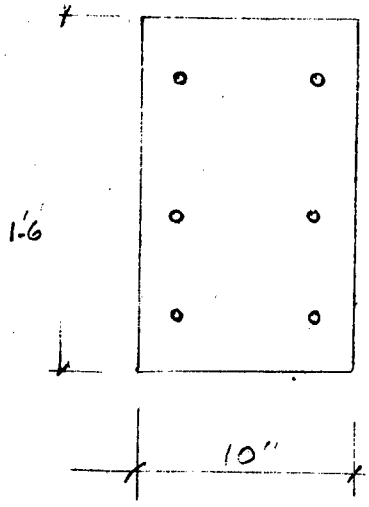
WELD R2

$T = C = 22^K$

$P = 40^K$

USE $3/4"\phi$ 1'-6" -G SHEAR STUDS

$N = 49/13.3 = 3$ USE 6



USE 10 x 5/8 x 1'-6" PL

$T = 22/20 = 1.1"$

USE (2) - 1/2 x 2" STRAP

(SAME DET @ PREV. COL.)

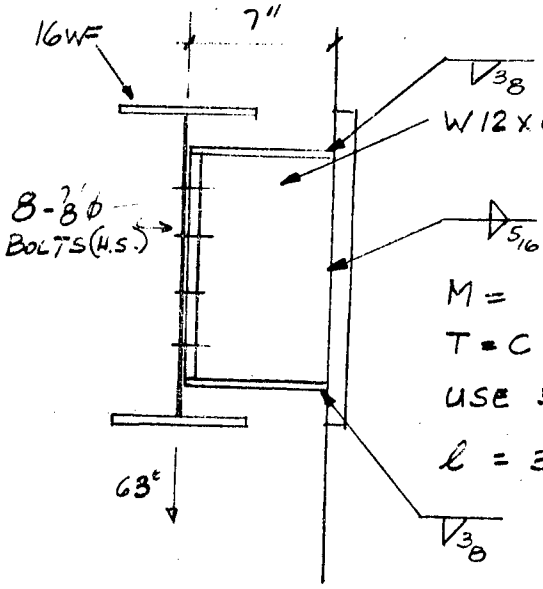
(MAKE SURE LS PREV. COL.)

USE TYPE 3 PL

FAA-STD-017

BY BK DATE ____ SUBJECT FAA TOWER SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ CONNECTIONS JOB NO ____

MICROWAVE LEVEL



USE 8 - 7/8 ϕ H.S. BOLTS
V = 8 x 9 = 72 k

M = 63 x 6.5 = 410 "k
T = C = 410/12 = 34 k
USE 3/8 WELD
ℓ = 34/4.8 = 7.1" USE 10"

VERT. WELD TO CARRY SHEAR

USE 5/16" WELD
ℓ = 63/4.0 = 15.8" USE 10' EA SIDE 5/16

WELD ℄

T = C = 34 k
P = 65 k

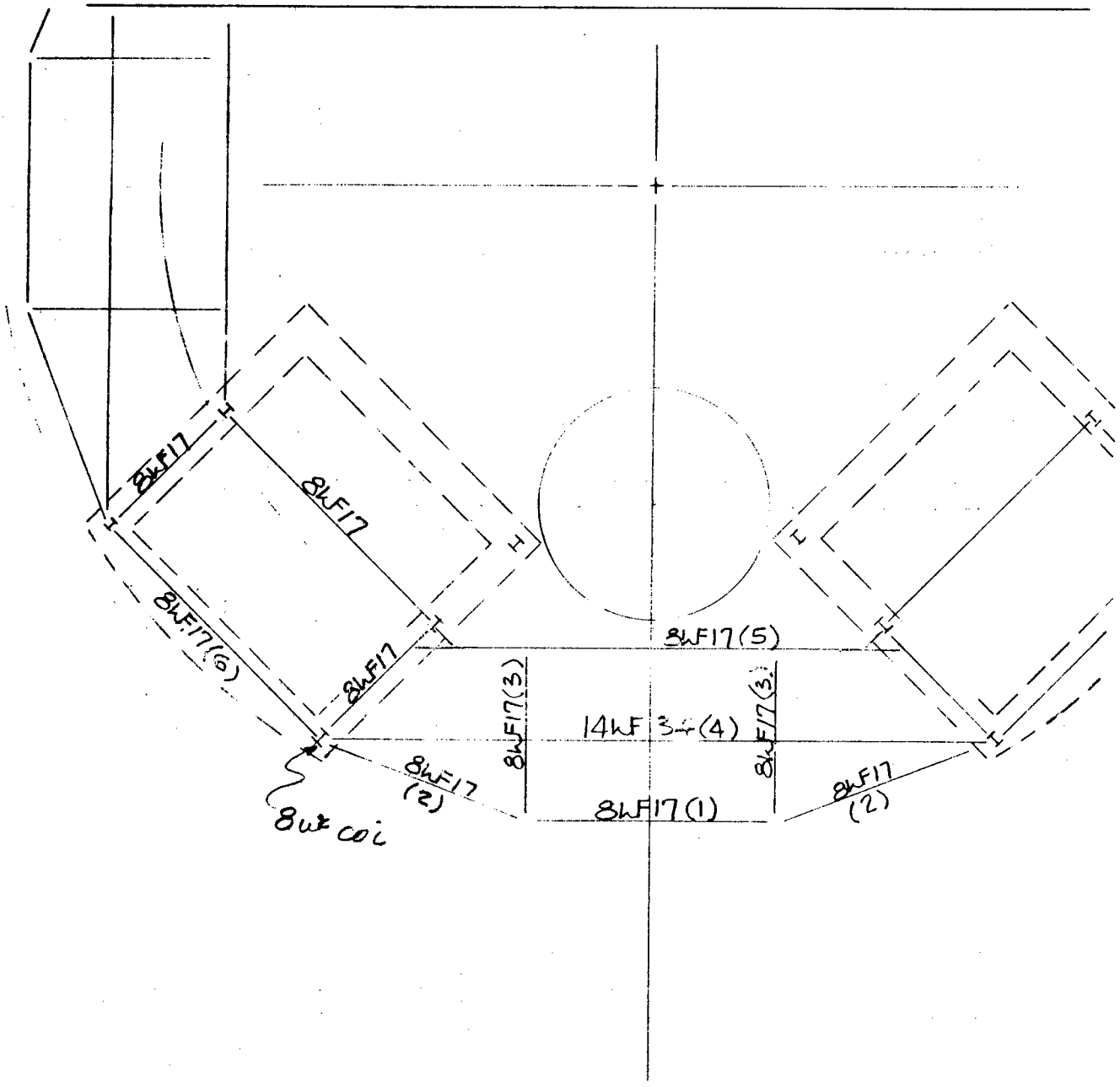
USE 3/4" ϕ x 5'-0" LG SUGOR STUDS
N = 65/13.3 = 4.9 USE 8

T = 34/20 = 1.70"
2½x½ STEEP (2) Δ = 2.50"

895

BY_____DATE_____ SUBJECT_____ SHEET NO._____OF_____

CHKD. BY_____DATE_____ _____ JOB NO._____



FAA-STD-017

BY BK DATE ____ SUBJECT F.A.L. TOWER SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ WALKWAY FRAMING JOB NO. ____

DECK + SLAB 50#/S.F.
MISC 10
60#/S.F. D.L.
50#/S.F. L.L.
110#/S.F. T.L.

BM-1

$\ell = 8'-0"$

$w = 2' \times .110 = .22^{k}/'$
$2' \times$ MISC. $= .30$ } $.52^{k}/'$

$M = .52 \times (8)^2/8 = 4.2'^{k}$
$V = .52 \times 8/2 = 2.1^{k}$

BWE 17

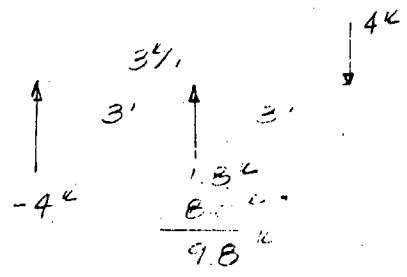
BM-2

$\ell = 7'-0"$ $w = .52^{k}/'$

$V = .52 \times 7/2 = 1.8^{k}$

BWE 17

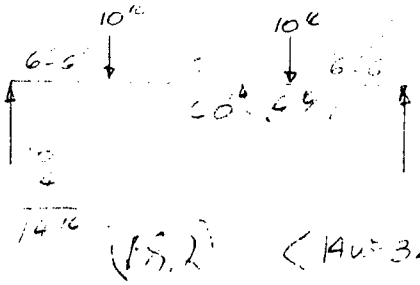
BM-3



$M = 4k \times 3 = 12$
$3k\,(3)^2/2 = 1.4$ } $13.4'^{k}$

BWE 17

BM-4



$w = 2' \times .110 = .22^{k}/'$
$B_1 \times$ MISC. $= .17$ } $.39^{k}/'$

$M = 14 \times 10 = 140$
$-10 \times 5 = -35$
$-4 \times 15^2/2 = -90$
65

(15.2) <14w=34> 915

BY BK DATE ____ SUBJECT FAA TOWER SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ WALKWAY FRAMING JOB NO. ____

BM-5

$\ell = 15' \pm$

(NEGLECT UPLIFT)

$w = 2 \times .110 = .22^k$
BM & WALL $= .50^k$ } $.72^k$

$M = .72k\,(15)^2/8 = 20.2^{ik}$ $\quad \phi = .7$

$V = .72 \times 15/2 = 5.4^k$

BM-6

$\ell = 9'0$

$w = 3.5 \times .110 = .39^k$
PARAPET $= .30$
MISC & BM $= .11$ } $.8^k$

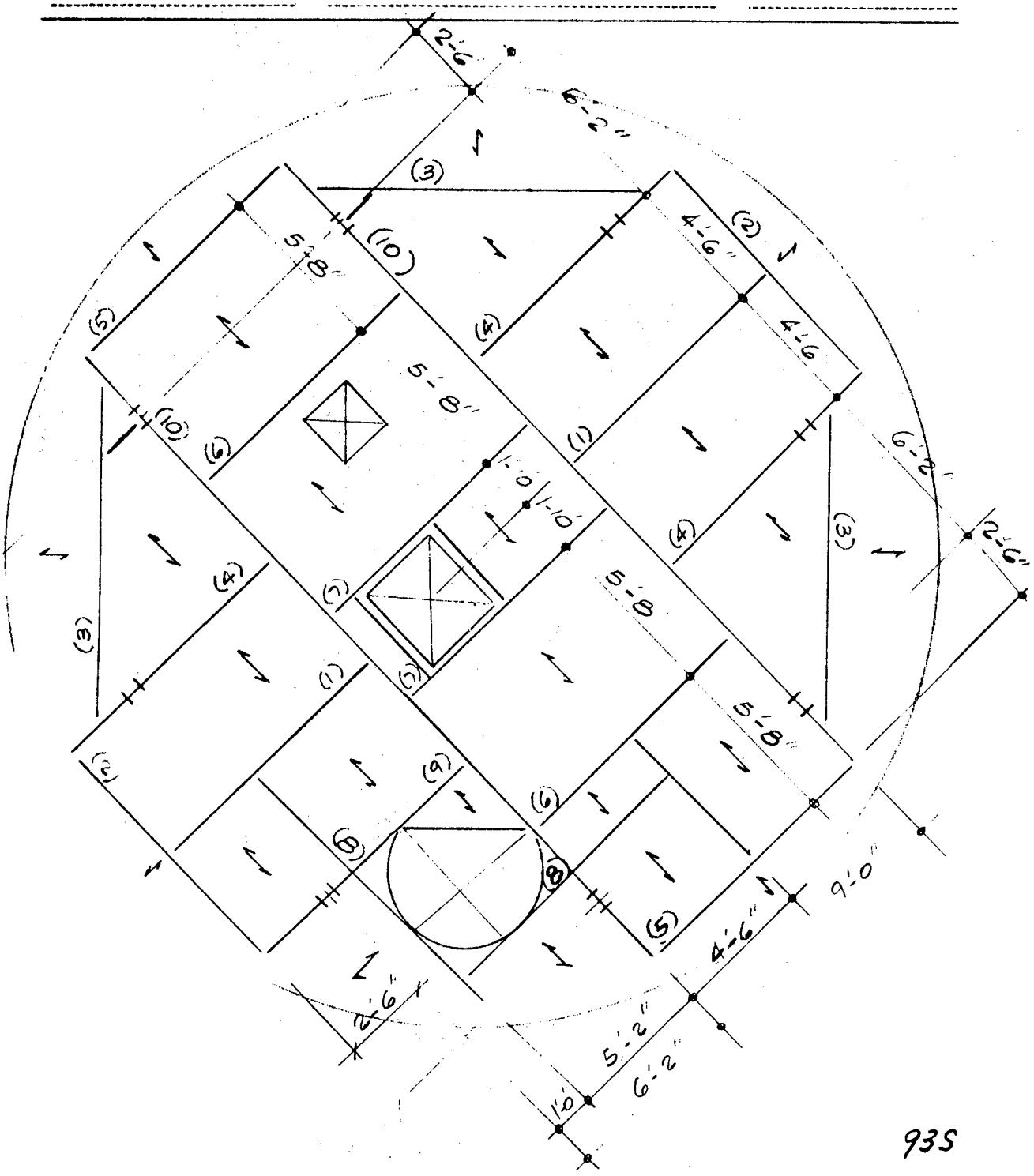
$V = .8k\ 9/2 = 3.6^k$

$M = .8k\,(9)^2/8 = 8.1^{ik}$ $\quad \phi = .7$

FAA-STD-017

BY BK DATE ____ SUBJECT CAB BASE NATIONAL STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____



935

BY BK DATE ____ SUBJECT CAB BASE NATIONAL STD. SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. ____

DECK + FILL 50 #/ft
CEIL. 5
MECH. 10
65 # D.L.
80 #/ft L.L.
145 # D + L. USE .15 k/ft

BM-1 ℓ = 8'-8"

w = 4.5 x .15 = .675 k/ft
BM = .025
} .7 k/ft

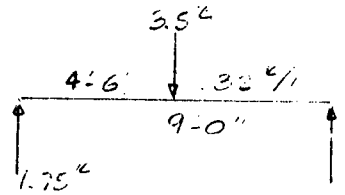
V = .7 x 8.67/2 = 3.04
Concrete = .50
} 3.54 k

M = .7 x (8.67)²/8 = 6.6
.5 x 8.67/4 = 1.1
} 7.8 ft-k

BWF 17

BM-2 ℓ = 9'-0

w = 2 x .15 = .30 k/ft
BM = .02
} .32 k/ft



M = 3.5 k x 9/4 = 7.9
.32 x (9)²/8 = 3.2
} 11.1 ft-k

BWF 17

FAA-STD-017

BY BK DATE ____ SUBJECT CAB BASE SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ NATIONAL STD. JOB NO. ____

BM-3 $\ell = 10\text{-}2''$

$w = 6 \times .15 = .90^{k/'}$
BM $= .03$ } $.93^{k/'}$

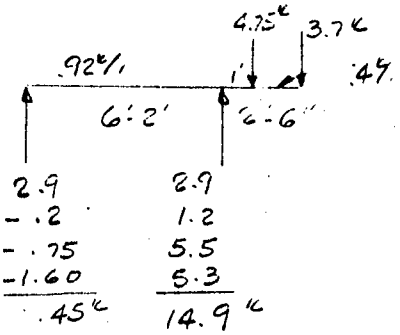
$V = .93 \times 10.2/2 = 4.75$
CONC. LD. $= .50$ } 5.25^{k}

$M = .93 \times (10.2)^2/8 = 12.1'^{k}$
$.5 \times 10.2/4 = 1.3$ } $13.4'^{k}$

BWF 17

BM-4

$w = 6 \times .15 = .90^{k/'}$
BM $= .02$ } $.92^{k/'}$



$M_{CONT} = 3.7^{k} \times 2.5 = 9.25'^{k}$
$4.75 \times 1.0 = 4.75$
$.4 \times (2.5)^2/2 = 1.25$
$15.25'^{k}$

W12X16.5

BM-5 $\ell = 9\text{-}0''$

$w = 5 \times .15 = .75^{k/'}$
BM $= .02$ } $.77^{k/'}$

$V = .77 \times 9/2 = 3.5$
CONC. LD $= 0.5$ } 4.0^{k}

$M = .77 \times (9)^2/8 = 7.8'^{k}$
$.5 \times 9/4 = 1.1$ } $8.9'^{k}$

BWF 17

955

BY BK DATE ____ SUBJECT CAB BASE NATIONAL STD SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ JOB NO ____

BM-6 $\ell = 9'-0"$

$w = 6 \times .15 = .9^{k}/_{'}$
$BM = .02$ } $.92^{k}/_{'}$

$V = .92 \times 9/2 = 4.2^{k}$
$CONC.\ LD = .5$ } 4.7^{k}

$M = .92 \times (9)^2/8 = 9.3^{'k}$
$.5 \times 9/4 = 1.1$ } $10.4^{'k}$ BWF 17

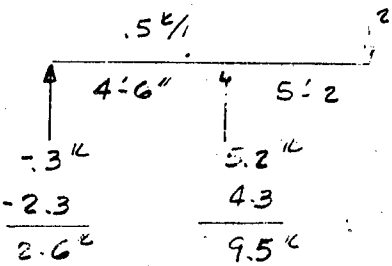
BM-7 $\ell = 9'-0"$ (SEE BM-5)

$w = 5 \times .15 = .75$
$BM = .02$ } $.77^{k}/_{'}$

$V = 4.0^{k}$
$M = 8.9^{'k}$ BWF 17

BM-8

$w = 3 \times .15 = .45^{k}/_{'}$
$BM = .02$ } $.47^{k}/_{'}$ USE $.5^{k}/_{'}$



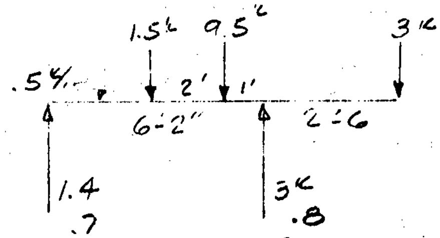
$M_{CANT} = 2 \times 5.2 = 10.4^{'k}$
$.5 \times (5.2)^2/2 = 6.8$ } $17.2^{'k}$

BWF 17

BY BK DATE SUBJECT CAB BASE SHEET NO. OF
CHKD. BY DATE JOB NO.
NATIONAL STD.

BM-9

wt = 3 x .15 = .45 } .48 k/' USE .5 k/'
Bm = .03



1.4	3k
.7	.8
1.5	8.0
-1.2	4.2
2.4k	16.0k

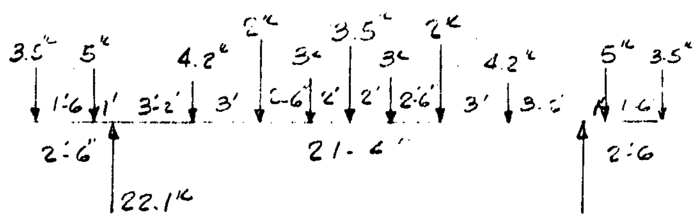
M_{CANT} = 2.5 x 3 = 7.5'k } 9.0'k
.5 x (2.5)²/2 = 1.5

+M = 3.2 x 3.4 = 10.9'k
- .5 x (3.4)²/2 = - 2.9
- 1.5 x .2 = - .3
7.7'k

8 WF 17

BM-10

wt = .2 k/'



$M_{CANT.}$ = 3.5 x 2.5 = 8.8 } 14.4'k
5 x 1.0 = 5.0
.2 x (2.5)²/2 = .6

+M = 22.1 x 10.7 = 235'k

- 3.5 x 13.2 = -46.2
- 5.0 x 11.7 = -58.5
- 4.2 x 7.5 = -31.5
- 2.0 x 4.5 = -9.0
- 3.0 x 2.0 = -6.0
- .2 x (13.2)²/2 = -17.5

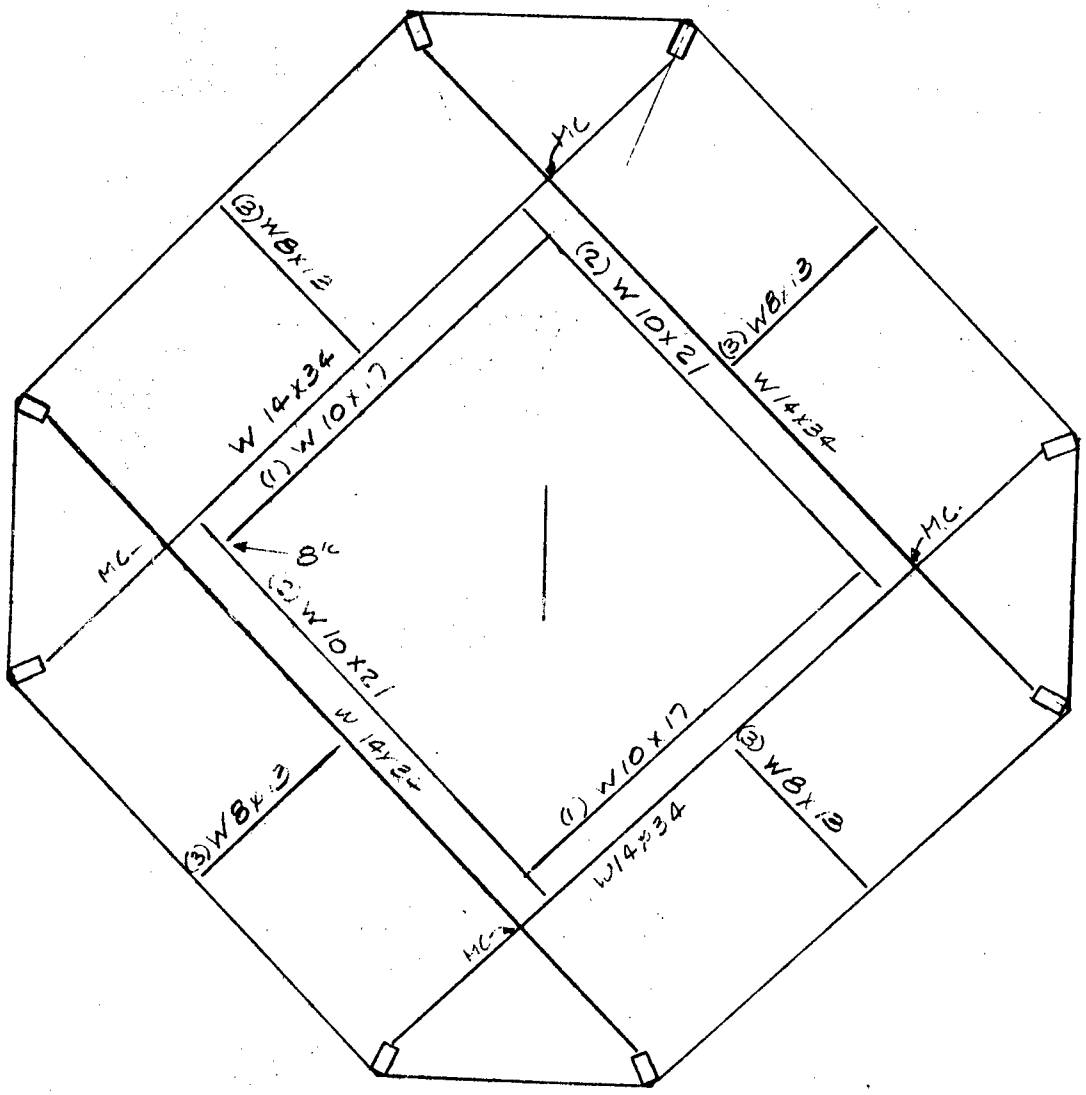
168.7 } 66.3'k ([illegible])

USE 14 WF 34 OK

FAA-STD-017

BY BK DATE ____ SUBJECT NATIONAL STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ 8 SIDED CAB ROOF JOB NO. ____



FAA-STD-017

BY BK DATE ____ SUBJECT NATIONAL STD SHEET NO ____ OF ____
CHKD. BY ____ DATE ____ 8 SIDED CAB ROOF JOB NO ____

CAB ROOF

L.L. 50#/D' + 60PSF –
W.L. { 60#/D' PRESSURE
84#/D' SUCTION ON L.D./DUCT MEMBERS

CAB FLOOR

L.L. 80#/D' + 500# CONC. LD.

< ASDE EQUIPMENT ON ROOF >

PLATFORM 8'-6½" RADIUS

D.L.

(1) RADOME 1.6K
(2) RADOR ANTENNA PEDESTAL & MOTOR } 1.7K
(3) ANTENNA REFLECTOR & SUPPORT .45

L.L.

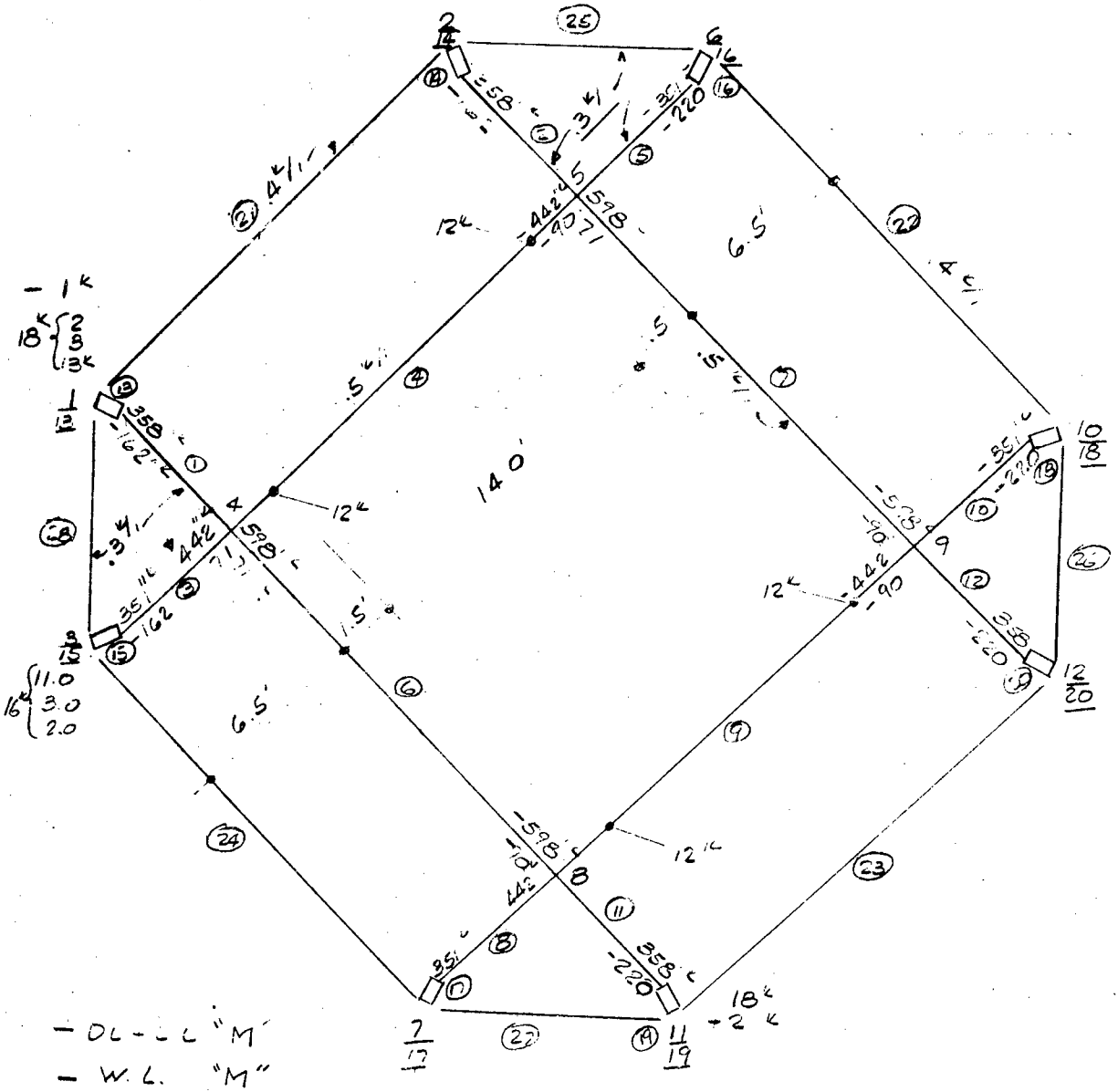
(1) RADOME 30#/D'
(2) RADOME PLATFORM } 30#/D'

LATERAL LOADS: 120 M.P.H.

FAA-STD-017

BY_____DATE_____ SUBJECT FAA NLT'L STD SHEET NO._____OF_____

CHKD. BY_____DATE_____ ROOF FRAMING JOB NO._____

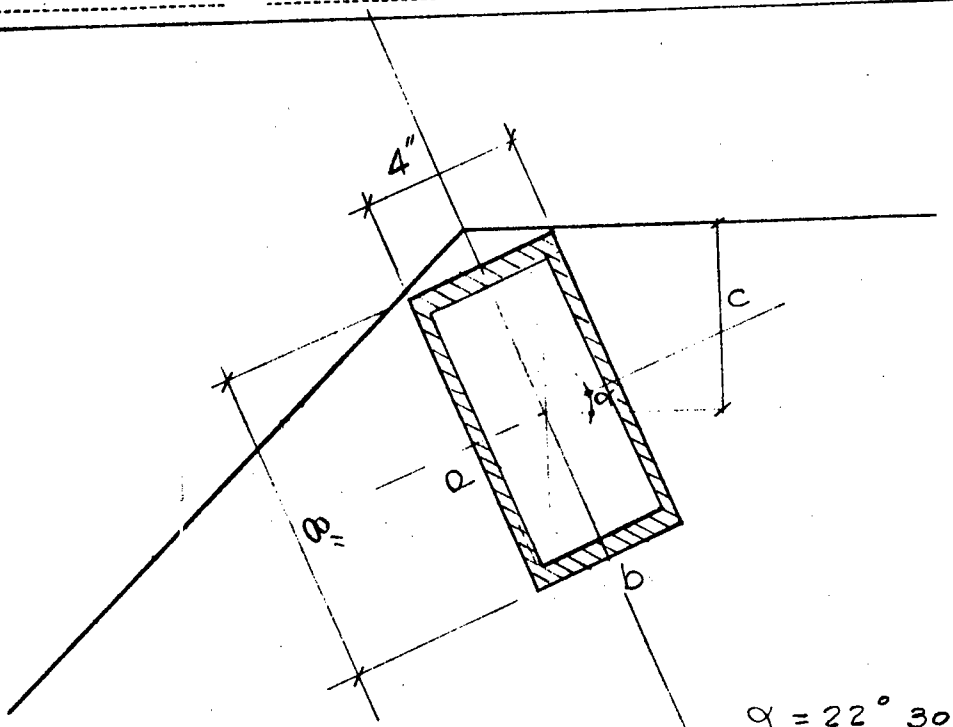


1005

FAA-STD-017

BY B.K. DATE ____ SUBJECT NAT'L. STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ 8 SIDED CLB JOB NO. ____



$\alpha = 22° 30'$

$\sin \alpha = .38268$

$\cos \alpha = .92388$

$$C_1 = \frac{4\,(.38267) + 8\,(.92388)}{7.3910} = 4.46''$$

$$I_1 = \frac{4 \times 8\left[\bar{4}^2\,(.38268)^2 + \bar{8}^2\,(.92388)^2\right]}{12} = 151.9\ in^4$$

$$S_1 = \frac{4 \times 8\left(\bar{4}^2\,(.38268)^2 + \bar{8}^2\,(.92388)^2\right)}{6\,(4 \times .38268 + 8 \times .92388)} = 34.05\ in^3$$

$$I_2 = \frac{(3.375)(6.75)\left[\bar{3.375}^2\,(.38268)^2 + \bar{6.75}^2\,(.92388)^2\right]}{12} = 77.0\ in^4$$

$I_{1-2} = 151.9 - 77.0 = 74.9\ in^4$ $\quad A = 9.22\ in^2$ 1015

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STRUCTURE ROOF OF 8-SIDED CAR - BLG - 2/1/71
TYPE SPACE FRAME
NUMBER OF JOINTS 20
NUMBER OF MEMBERS 28
NUMBER OF SUPPORTS 8
NUMBER OF LOADINGS 3
TABULATE ALL
JOINT COORDINATES
13 360. -174. 78. S
 1 360. 0. 78.
14 360. -174. 282. S
 2 360. 0. 282.
15 282. -174. 0. S
 3 282. 0.   0.
 4 282. 0.  78.
 5 282. 0. 282.
16 282. -174. 360. S
 6 282. 0. 360.
17 78. -174. 0. S
 7  78. 0.   0.
 8  78. 0.  78.
 9  78. 0. 282.
18 78. -174. 360. S
10  78. 0. 360.
19 0. -174. 78. S
11   0. 0.  78.
20 0. -174. 282. S
12   0. 0. 282.
MEMBER INCIDENCES
 1  1  4
 2  2  5
 3  3  4
 4  4  5
 5  5  6
 6  4  8
 7  5  9
 8  7  8
 9  8  9
10  9 10
11  8 11
12  9 12
13 13  1
14 14  2
15 15  3
16 16  6
17 17  7
18 18 10
19 19 11
20 20 12
21  1  2
22  6 10
23 12 11
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24  7  3
25  2  5
26 10 12
27 11  7
28  3  1
MEMBER RELEASES
21 START MOMENT Z END MOMENT Z
22 START MOMENT Z END MOMENT Z
23 START MOMENT Z END MOMENT Z
24 START MOMENT Z END MOMENT Z
25 START MOMENT Z END MOMENT Z
26 START MOMENT Z END MOMENT Z
27 START MOMENT Z END MOMENT Z
28 START MOMENT Z END MOMENT Z
MEMBER PROPERTIES PRISMATIC
1 THRU 12 AX 10.0 IX 0.5 IY 0.5 IZ 340.0
13 THRU 14 AX 8.06 IX 0.5 IY 27.0 IZ 61.7
15 THRU 18 AX 8.06 IX 0.5 IY 61.7 IZ 27.0
19 THRU 20 AX 8.06 IX 0.5 IY 27.0 IZ 61.7
21 THRU 24 AX 5.04 IX 0.5 IY 0.5 IZ 36.7
25 THRU 28 AX 4.54 IX 0.5 IY 0.5 IZ 29.2
CONSTANTS E 29000. ALL
LOADING 1 GRAVITY LOAD
MEMBER LOADS
 1 FORCE Y UNIF -0.0250
 2 FORCE Y UNIF -0.0250
 3 FORCE Y UNIF -0.0250
 5 FORCE Y UNIF -0.0250
 8 FORCE Y UNIF -0.0250
10 FORCE Y UNIF -0.0250
11 FORCE Y UNIF -0.0250
12 FORCE Y UNIF -0.0250
 4 FORCE Y UNIF -0.0416
 6 FORCE Y UNIF -0.0416
 7 FORCE Y UNIF -0.0416
 9 FORCE Y UNIF -0.0416
 4 FORCE Y CONC P -12.0 L 18.
 4 FORCE Y CONC P -12.0 L 186.
 9 FORCE Y CONC P -12.0 L  18.
 9 FORCE Y CONC P -12.0 L 186.
21 FORCE Y UNIF -0.0333
22 FORCE Y UNIF -0.0333
23 FORCE Y UNIF -0.0333
24 FORCE Y UNIF -0.0333
25 FORCE Y UNIF -0.0250
26 FORCE Y UNIF -0.0250
27 FORCE Y UNIF -0.0250
28 FORCE Y UNIF -0.0250
LOADING 2 WIND FROM NORTH
MEMBER LOADS
13 FORCE Y UNIF  0.0416
14 FORCE Y UNIF  0.0416
15 FORCE Y UNIF  0.0104
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16 FORCE Y UNIF  0.0104
JOINT LOADS
 1 FORCE X -1.5
 2 FORCE X -1.5
 3 FORCE X -0.375
 6 FORCE X -0.375
 1 MOMENT Z 27.0
 2 MOMENT Z 27.0
 3 MOMENT Z 6.75
 6 MOMENT Z 6.75
LOADING 3 WIND FROM EAST
MEMBER LOADS
15 FORCE Z UNIF  0.0416
17 FORCE Z UNIF  0.0416
18 FORCE Z UNIF  0.0104
19 FORCE Z UNIF  0.0104
JOINT LOADS
 2 FORCE Z 1.5
 7 FORCE Z 1.5
 1 FORCE Z 0.375
11 FORCE Z 0.375
 2 MOMENT X 27.0
 7 MOMENT X 27.0
 1 MOMENT X 6.75
11 MOMENT X 6.75
TRACE
SOLVE
PROBLEM CORRECTLY SPECIFIED, EXECUTION TO PROCEED.
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STRUCTURE ROOF OF 3-SIDED CAB - BLG - 2/1/71

LOADING 1 GRAVITY LOAD

MEMBER FORCES

	MEMB	JOINT	AXIAL FORCE	SHEAR FORCE Y	SHEAR FORCE Z	TORSION MOMENT	MOMENT Y	MOMENT Z
BM	1	1	2.209	13.237	0.000	0.59	-0.00	358.33
	1	4	-2.209	-11.287	-0.000	-0.59	-0.00	598.16
	2	2	2.208	13.237	-0.000	-0.59	0.00	358.33
	2	5	-2.208	-11.287	0.000	0.59	0.00	598.16
	3	3	2.149	11.148	-0.000	-0.56	0.00	351.44
	3	4	-2.149	-9.198	0.000	0.56	0.00	442.09
	4	4	2.149	16.243	-0.000	0.00	0.00	-441.49
	4	5	-2.149	16.243	0.000	-0.00	0.00	441.49
	5	5	2.149	-9.198	0.000	0.56	-0.00	-442.09
	5	6	-2.149	11.148	-0.000	-0.56	-0.00	-351.44
BM	6	4	2.209	4.243	-0.000	-0.00	0.00	-597.59
	6	8	-2.209	4.243	0.000	0.00	0.00	597.59
	7	5	2.208	4.243	-0.000	0.00	0.00	-597.59
	7	9	-2.208	4.243	0.000	-0.00	0.00	597.59
	8	7	2.149	11.148	0.000	0.56	-0.00	351.44
	8	8	-2.149	-9.198	-0.000	-0.56	-0.00	442.09
	9	8	2.149	16.243	-0.000	-0.00	0.00	-441.49
	9	9	-2.149	16.243	0.000	0.00	0.00	441.49
	10	9	2.149	-9.198	-0.000	-0.56	0.00	-442.09
	10	10	-2.149	11.148	0.000	0.56	0.00	-351.44
BM	11	8	2.209	-11.287	-0.000	-0.59	0.00	-598.16
	11	11	-2.209	13.237	0.000	0.59	0.00	-358.34
	12	9	2.208	-11.287	0.000	0.59	-0.00	-598.16
	12	12	-2.208	13.237	-0.000	-0.59	-0.00	-358.34
COL.	13	13	18.013	3.087	0.004	-0.00	-0.24	178.92
	13	1	-18.013	-3.087	-0.004	0.00	-0.59	358.33
	14	14	18.013	3.087	-0.004	0.00	0.24	178.92
	14	2	-18.013	-3.087	0.004	-0.00	0.59	358.33
	15	15	15.924	0.004	3.028	0.00	-175.48	0.23
	15	3	-15.924	-0.004	-3.028	-0.00	-351.45	0.57
	16	16	15.924	0.004	-3.028	-0.00	175.48	0.23
	16	6	-15.924	-0.004	3.028	0.00	351.45	0.57

17	17	15.923	-0.004	3.028	-0.00	-175.48	-0.23
17	7	-15.923	0.004	-3.028	0.00	-351.45	-0.57
18	18	15.923	-0.004	-3.028	0.00	175.49	-0.23
18	10	-15.923	0.004	3.028	-0.00	351.45	-0.57
19	19	18.013	-3.087	0.004	0.00	-0.24	-178.92
19	11	-18.013	3.087	-0.004	-0.00	-0.59	-358.33
20	20	18.013	-3.087	-0.004	-0.00	0.25	-178.92
20	12	-18.013	3.087	0.004	0.00	0.59	-358.33
21	1	0.883	3.396	-0.000	0.00	0.00	0.00
21	2	-0.883	3.396	0.000	-0.00	-0.00	0.00
22	6	0.883	3.396	-0.000	0.00	0.00	0.00
22	10	-0.883	3.396	0.000	-0.00	-0.00	0.00
23	12	0.883	3.396	-0.000	-0.00	0.00	0.00
23	11	-0.883	3.396	0.000	0.00	-0.00	0.00
24	7	0.883	3.396	-0.000	0.00	0.00	0.00
24	3	-0.883	3.396	0.000	0.00	-0.00	0.00
25	2	1.242	1.378	0.000	0.00	-0.00	0.00
25	6	-1.242	1.378	-0.000	-0.00	0.00	0.00
26	10	1.242	1.378	-0.000	-0.00	-0.00	0.00
26	12	-1.242	1.378	0.000	0.00	0.00	0.00
27	11	1.242	1.378	0.000	0.00	-0.00	0.00
27	7	-1.242	1.378	-0.000	-0.00	0.00	0.00
28	3	1.242	1.378	-0.000	-0.00	-0.00	0.00
28	1	-1.242	1.378	0.000	0.00	0.00	0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
1	0.000	0.000	-0.000	-0.00	-0.00	0.00
2	0.000	0.000	-0.000	0.00	-0.00	0.00
3	0.000	-0.000	-0.000	-0.00	-0.00	-0.00
4	-0.000	-0.000	0.000	0.00	-0.00	0.00
5	-0.000	0.000	0.000	-0.00	0.00	0.00
6	0.000	-0.000	0.000	-0.00	0.00	-0.00
7	-0.000	0.000	0.000	-0.00	0.00	-0.00
8	-0.000	-0.000	0.000	-0.00	0.00	-0.00
9	-0.000	0.000	-0.000	-0.00	0.00	-0.00
10	0.000	0.000	0.000	-0.00	-0.00	0.00
11	-0.000	0.000	-0.000	-0.00	-0.00	-0.00
12	-0.000	-0.000	0.000	-0.00	0.00	-0.00

REACTIONS: APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
13	-3.087	18.013	0.004	0.24	-0.00	178.92
14	-3.087	18.013	-0.004	-0.24	0.00	178.92
15	-0.004	15.924	3.028	175.48	0.00	0.23

16	-0.004	15.924	-3.028	-175.48	-0.00	0.23
17	0.004	15.923	3.028	175.48	-0.00	-0.23
18	0.004	15.923	-3.028	-175.49	0.00	-0.23
19	3.087	18.013	0.004	0.24	0.00	-178.92
20	3.087	18.013	-0.004	-0.25	-0.00	-178.92

FREE JOINT DISPLACEMENTS

JOINT	X DISPL	Y DISPL	Z DISPL	X-ROTAT	Y-ROTAT	Z-ROTAT
1	-0.0013	-0.0134	0.0006	0.0000	0.0000	0.0087
2	-0.0013	-0.0134	-0.0006	-0.0000	-0.0000	0.0087
3	-0.0006	-0.0118	0.0013	0.0085	-0.0000	0.0000
4	-0.0007	-0.7021	0.0007	0.0080	-0.0000	0.0076
5	-0.0007	-0.7021	-0.0007	-0.0080	0.0000	0.0076
6	-0.0006	-0.0118	-0.0013	-0.0085	0.0000	0.0000
7	0.0006	-0.0118	0.0013	0.0085	0.0000	-0.0000
8	0.0007	-0.7021	0.0007	0.0080	0.0000	-0.0076
9	0.0007	-0.7021	-0.0007	-0.0080	-0.0000	-0.0076
10	0.0006	-0.0118	-0.0013	-0.0085	-0.0000	-0.0000
11	0.0013	-0.0134	0.0006	0.0000	-0.0000	-0.0087
12	0.0013	-0.0134	-0.0006	-0.0000	0.0000	-0.0087

STRUCTURE ROOF OF 8-SIDED CAB - BLG - 2/1/71

LOADING 2 WIND FROM NORTH

MEMBER FORCES

MEMB	JOINT	AXIAL FORCE	SHEAR FORCE Y	SHEAR FORCE Z	TORSION MOMENT	MOMENT Y	MOMENT Z
1	1	2.207	-1.183	-0.000	0.01	0.00	-162.87
1	4	-2.207	1.183	0.000	-0.01	0.00	70.57
2	2	2.205	-1.184	0.000	-0.01	0.00	-162.97
2	5	-2.205	1.184	-0.000	0.01	-0.00	70.59
3	3	0.038	0.394	0.000	0.42	-0.00	10.43
3	4	-0.038	-0.394	-0.000	-0.42	-0.00	20.36
4	4	0.038	0.000	0.000	-0.00	0.00	-20.33
4	5	-0.038	-0.000	-0.000	0.00	-0.00	20.38
5	5	0.038	-0.395	-0.000	-0.42	0.00	-20.41
5	6	-0.038	0.395	0.000	0.42	0.00	-10.42
6	4	2.209	-0.788	-0.000	-0.01	0.00	-70.99
6	8	-2.209	0.788	0.000	0.01	0.00	-89.89
7	5	2.208	-0.788	0.000	0.01	-0.00	-71.01
7	9	-2.208	0.788	-0.000	-0.01	-0.00	-89.89
8	7	-0.661	-0.879	0.000	0.48	-0.00	-23.04
8	8	0.661	0.879	-0.000	-0.48	-0.00	-45.59
9	8	-0.661	-0.000	0.000	0.00	0.00	45.54
9	9	0.661	0.000	-0.000	-0.00	-0.00	-45.56
10	9	-0.661	0.881	-0.000	-0.48	0.00	45.61
10	10	0.661	-0.881	0.000	0.48	0.00	23.11
11	8	2.208	-1.668	-0.000	0.03	0.00	89.40
11	11	-2.208	1.668	0.000	-0.03	0.00	-219.55
12	9	2.207	-1.670	0.000	-0.03	-0.00	89.40
12	12	-2.207	1.670	-0.000	0.03	-0.00	-219.67
13	13	-1.183	-6.479	0.001	0.00	-0.05	-361.86
13	1	1.183	-0.759	-0.001	-0.00	-0.14	-135.74
14	14	-1.184	-6.480	-0.001	0.00	0.08	-361.98
14	2	1.184	-0.758	0.001	-0.00	0.14	-135.84
15	15	0.394	-1.420	0.088	-0.00	-5.13	-95.99
15	3	-0.394	-0.388	-0.088	0.00	-10.27	6.19
16	16	0.395	-1.421	-0.088	0.00	5.12	-96.05
16	6	-0.395	-0.388	0.088	-0.00	10.27	6.19
17	17	-0.879	-0.348	-0.196	-0.00	11.33	-59.96

	17	7	0.879	0.348	0.196	0.00	22.86	-0.63
	18	18	-0.882	-0.349	0.197	0.00	-11.41	-0.62
	18	10	0.882	0.348	-0.197	-0.00	-22.94	-0.64
COL.	19	19	1.668	-2.673	-0.001	-0.00	0.09	-245.77
COL.	19	11	-1.668	2.673	0.001	0.00	0.18	-219.40
	20	20	1.670	-2.674	0.001	0.00	-0.14	-245.89
	20	12	-1.670	2.674	-0.001	-0.00	-0.18	-219.51
	21	1	0.051	0.000	0.000	-0.00	-0.00	-0.00
	21	2	-0.051	-0.000	-0.000	0.00	-0.00	0.00
	22	6	0.812	-0.000	0.000	0.02	-0.00	0.00
	22	10	-0.812	0.000	-0.000	-0.02	-0.00	-0.00
	23	12	0.463	-0.000	0.000	-0.00	-0.00	0.00
	23	11	-0.463	0.000	-0.000	0.00	0.00	-0.00
	24	7	0.813	0.000	-0.000	-0.02	0.00	0.00
	24	3	-0.813	-0.000	0.000	0.02	0.00	0.00
	25	2	0.070	-0.000	0.000	-0.18	-0.00	-0.00
	25	6	-0.070	0.000	-0.000	0.18	-0.00	-0.00
	26	10	0.655	-0.000	-0.000	-0.21	0.00	0.00
	26	12	-0.655	0.000	0.000	0.21	0.00	-0.00
	27	11	0.656	0.000	0.000	0.21	-0.00	0.00
	27	7	-0.656	-0.000	-0.000	-0.21	-0.00	0.00
	28	3	0.070	0.000	-0.000	0.18	0.00	-0.00
	28	1	-0.070	-0.000	0.000	-0.18	0.00	0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
1	-1.498	0.000	0.000	-0.00	-0.00	27.00
2	-1.497	0.000	-0.000	-0.00	0.00	27.00
3	-0.374	-0.000	-0.000	-0.00	0.00	6.75
4	-0.001	-0.000	-0.000	0.00	-0.00	-0.00
5	-0.002	-0.000	-0.000	0.00	0.00	-0.00
6	-0.374	0.000	0.000	-0.00	0.00	6.74
7	0.000	-0.000	-0.000	0.00	0.00	-0.00
8	0.001	0.000	-0.000	0.00	0.00	0.00
9	0.001	-0.000	-0.000	0.00	0.00	-0.00
10	0.000	0.001	-0.000	-0.00	0.00	-0.00
11	-0.000	-0.000	0.000	0.00	-0.00	-0.00
12	-0.003	0.000	-0.001	0.00	-0.00	0.00

REACTIONS, APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
13	6.479	-1.183	0.001	0.05	0.00	-361.86
14	6.480	-1.184	-0.001	-0.08	0.00	-361.98
15	1.420	0.394	0.088	5.13	-0.00	-95.99
16	1.421	0.395	-0.088	-5.12	0.00	-96.05

17	0.348	-0.879	-0.196	-11.33	-0.00	-59.96
18	0.348	-0.882	0.197	11.41	0.00	-60.02
19	2.673	1.668	-0.001	-0.09	-0.00	-245.77
20	2.674	1.670	0.001	0.14	0.00	-245.89

FREE JOINT DISPLACEMENTS

JOINT	X DISPL	Y DISPL	Z DISPL	X-ROTAT	Y-ROTAT	Z-ROTAT
1	-0.7702	0.0008	0.0002	0.0000	-0.0000	0.0007
2	-0.7705	0.0008	0.0001	-0.0000	-0.0000	0.0007
3	-0.7699	-0.0002	-0.0000	0.0002	0.0000	0.0055
4	-0.7696	-0.0198	-0.0000	0.0002	0.0000	-0.0001
5	-0.7699	-0.0198	-0.0000	-0.0002	-0.0000	-0.0001
6	-0.7706	-0.0002	-0.0000	-0.0002	-0.0000	0.0055
7	-0.7687	0.0006	-0.0005	-0.0005	0.0000	0.0065
8	-0.7680	0.0444	-0.0003	-0.0004	0.0000	0.0000
9	-0.7684	0.0444	0.0001	0.0004	-0.0000	0.0000
10	-0.7695	0.0006	0.0002	0.0005	-0.0000	0.0065
11	-0.7674	-0.0012	-0.0000	-0.0000	0.0000	0.0012
12	-0.7678	-0.0012	-0.0006	0.0000	-0.0000	0.0012

STRUCTURE ROOF OF 8-SIDED CAB - BLG - 2/1/71

LOADING 3 WIND FROM EAST

MEMBER FORCES

	MEMB	JOINT	AXIAL FORCE	SHEAR FORCE Y	SHEAR FORCE Z	TORSION MOMENT	MOMENT Y	MOMENT Z
	1	1	0.039	0.394	-0.000	-0.42	0.00	10.43
	1	4	-0.039	-0.394	0.000	0.42	0.00	20.36
	2	2	-0.660	-0.880	-0.000	-0.48	0.00	-23.06
	2	5	0.660	0.880	0.000	0.48	0.00	-45.59
BM	3	3	2.207	-1.183	0.000	-0.01	0.00	-162.92
	3	4	-2.207	1.183	-0.000	0.01	-0.00	70.61
BM	4	4	2.208	-0.788	0.000	0.01	-0.00	-71.03
	4	5	-2.208	0.788	-0.000	-0.01	-0.00	-89.92
BM	5	5	2.208	-1.668	0.000	-0.03	-0.00	89.43
	5	6	-2.208	1.668	-0.000	0.03	-0.00	-219.61
	6	4	0.039	0.000	0.000	-0.00	-0.00	-20.33
	6	8	-0.039	-0.000	-0.000	0.00	-0.00	20.41
	7	5	-0.660	-0.000	0.000	-0.00	-0.00	45.53
	7	9	0.660	0.000	-0.000	0.00	0.00	-45.59
	8	7	2.206	-1.185	-0.000	0.01	0.00	-163.11
	8	8	-2.206	1.185	0.000	-0.01	0.00	70.64
	9	8	2.209	-0.789	-0.000	-0.01	0.00	-71.06
	9	9	-2.209	0.789	0.000	0.01	0.00	-89.94
	10	9	2.209	-1.671	-0.000	0.03	0.00	89.45
	10	10	-2.209	1.671	0.000	-0.03	0.00	-219.80
	11	8	0.039	-0.395	0.000	0.42	-0.00	-20.44
	11	11	-0.039	0.395	-0.000	-0.42	-0.00	-10.43
	12	9	-0.660	0.881	0.000	0.48	-0.00	45.65
	12	12	0.660	-0.881	-0.000	-0.48	-0.00	23.11
	13	13	0.394	0.088	-1.420	0.00	96.01	5.13
	13	1	-0.394	-0.088	-0.388	-0.00	-6.19	10.28
	14	14	-0.880	-0.196	-0.348	0.00	59.98	-11.36
	14	2	0.880	0.196	0.348	-0.00	0.63	-22.88
COL.	15	15	-1.183	0.001	-6.479	-0.00	361.92	0.05
	15	3	1.183	-0.001	-0.758	0.00	135.79	0.14
COL.	16	16	1.668	-0.001	-2.674	0.00	245.83	-0.10
	16	6	-1.668	0.001	2.674	-0.00	219.45	-0.18
	17	17	-1.185	-0.001	-6.481	-0.00	362.13	-0.08

17	7	1.185	0.001	-0.756	0.00	135.98	-0.14
18	18	1.672	0.001	-2.676	-0.00	246.04	0.13
18	10	-1.672	-0.001	2.676	0.00	219.65	0.18
19	19	0.395	-0.088	-1.421	-0.00	96.08	-5.13
19	11	-0.395	0.088	-0.388	0.00	-6.19	-10.28
20	20	-0.881	0.197	-0.348	-0.00	60.06	11.40
20	12	0.881	-0.197	0.348	0.00	0.64	22.93
21	1	0.812	-0.000	0.000	0.02	-0.00	0.00
21	2	-0.812	0.000	-0.000	-0.02	-0.00	-0.00
22	6	0.462	-0.000	0.000	0.00	-0.00	0.00
22	10	-0.462	0.000	-0.000	-0.00	0.00	-0.00
23	12	0.812	0.000	-0.000	-0.02	0.00	-0.00
23	11	-0.812	-0.000	0.000	0.02	0.00	0.00
24	7	0.050	0.000	0.000	0.00	-0.00	-0.00
24	3	-0.050	-0.000	-0.000	-0.00	0.00	0.00
25	2	0.655	-0.000	-0.000	-0.21	0.00	0.00
25	6	-0.655	0.000	0.000	0.21	0.00	-0.00
26	10	0.663	0.000	0.000	0.21	-0.00	0.00
26	12	-0.663	-0.000	-0.000	-0.21	-0.00	0.00
27	11	0.069	0.000	-0.000	0.18	0.00	-0.00
27	7	-0.069	-0.000	0.000	-0.18	0.00	0.00
28	3	0.070	-0.000	0.000	-0.18	-0.00	0.00
28	1	-0.070	0.000	-0.000	0.18	-0.00	-0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
1	-0.000	0.000	0.374	6.75	-0.00	0.00
2	0.000	-0.000	-0.000	0.00	0.00	-0.00
3	0.000	-0.000	1.498	26.99	0.00	-0.00
4	0.000	-0.000	0.000	0.00	-0.00	0.00
5	0.000	-0.000	0.000	0.00	-0.00	-0.00
6	-0.000	0.000	0.001	0.00	-0.00	-0.00
7	0.000	0.000	1.499	27.00	-0.00	-0.00
8	0.000	-0.000	0.002	-0.00	-0.00	-0.00
9	-0.000	-0.000	-0.000	0.00	0.00	0.00
10	-0.004	-0.001	-0.002	0.00	-0.00	0.00
11	-0.000	0.000	0.375	6.75	0.00	0.00
12	0.005	-0.000	0.005	0.00	0.00	-0.00

REACTIONS, APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	FORCE Z	MOMENT X	MOMENT Y	MOMENT Z
13	-0.088	0.394	-1.420	-96.01	0.00	5.13
14	0.196	-0.880	-0.348	-59.98	0.00	-11.36
15	-0.001	-1.183	-6.479	-361.92	-0.00	0.05
16	0.001	1.668	-2.674	-245.83	0.00	-0.10

17	0.001	-1.185	-6.481	-362.13	-0.00	-0.08
18	-0.001	1.672	-2.676	-246.04	-0.00	0.13
19	0.088	0.395	-1.421	-96.08	-0.00	-5.13
20	-0.197	-0.881	-0.348	-60.06	-0.00	11.40

FREE JOINT DISPLACEMENTS

JOINT	X DISPL	Y DISPL	Z DISPL	X-ROTAT	Y-ROTAT	Z-ROTAT
1	-0.0000	-0.0002	0.7701	0.0055	-0.0000	0.0002
2	0.0004	0.0006	0.7689	0.0065	-0.0000	-0.0005
3	-0.0001	0.0008	0.7704	0.0007	0.0000	0.0000
4	0.0000	-0.0198	0.7698	-0.0001	-0.0000	0.0002
5	0.0002	0.0444	0.7682	0.0000	-0.0000	-0.0004
6	-0.0000	-0.0012	0.7676	0.0012	-0.0000	-0.0000
7	-0.0001	0.0008	0.7710	0.0007	0.0000	-0.0000
8	0.0000	-0.0198	0.7704	-0.0001	0.0000	-0.0002
9	-0.0001	0.0444	0.7688	0.0000	0.0000	0.0004
10	0.0005	-0.0012	0.7683	0.0012	0.0000	0.0000
11	0.0000	-0.0002	0.7711	0.0055	0.0000	-0.0002
12	-0.0003	0.0006	0.7699	0.0066	0.0000	0.0005

FAA-STD-017

BY BK DATE ____ SUBJECT NLT'L STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

8 SIDED CAB ROOF

BM-1

$\ell = 14'-0''$

$w = 70 \times .5 = .105^{k/'}$

WALL $= .100$

BM $= .020$

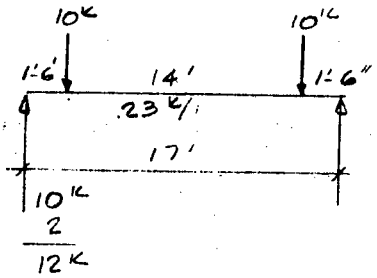
$.225^{k/'}$

$M = .23 \times (14)^2/8 = 5.6^{'k}$

$V = .23 \times 14/2 = 1.6^{k}$

USE W10 x 17

BM-2



$M = 1.5 \times 10 = 15^{'k}$

$.23 \times (17)^2/8 = 8.4$

$23.4^{'k}$

USE W 10 x 21

BM-3 $\ell = 6.5' \pm$

$w = 2 \times .70 = .140$

BM $= .020$

$.160^{k/'}$ USE $.20^{k/'}$

$M = .2 \times (6.5)^2/8 = 1.06^{'k}$

$V = .2 \times 6.5/2 = .65^{k}$

USE W 8, 13

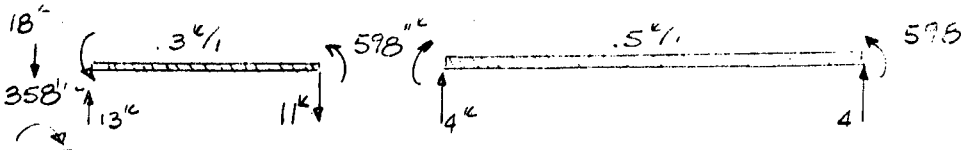
FAA-STD-017

BY BK DATE ____ SUBJECT FAA-NAT'L STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

200# FRAME

D.L. + L.L



BEAM

$+M = 4 \times 7 \times 12 = 336''^k$

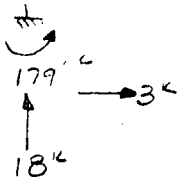
$= 598''^k$ } 934

$-.5 \times (7)^2/2 \times 2 = -147$

$787''^k$

$f_s = 787/48 = 16.4$ KSI

$P/A = 2.0/10 = .22$ KSI OK



W 14 x 34

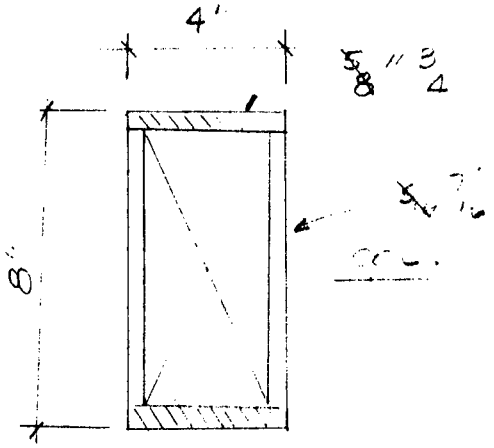
COLUMN

$P/A = 18/9.22 = 1.95$ KSI

$f_s = 358 \times 4.5/74.9 = 21.60$ KSI

23.45 KSI

SMALL OVERSTRESS



NOTE: DUE TO SMALL OVERSTRESS & OPPOSITE REQUIRED IN COL. PLATE SIZES HAVE BEEN INCREASED TO ¾" END & ⅝ SIDE.

<DWG. REVISED>

1145

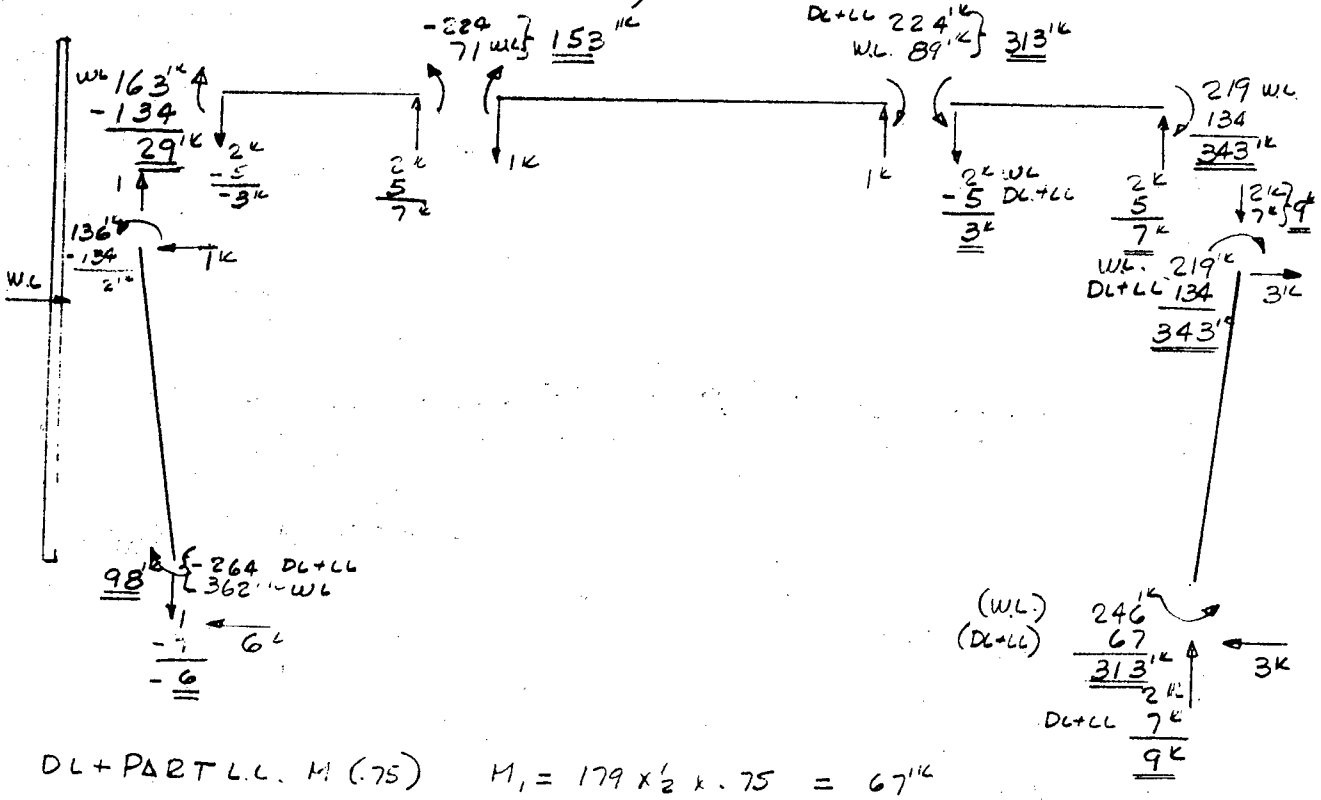
FAA-STD-017

BY BK DATE ____ SUBJECT FAA NAT'L STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ ROOF FRAMING JOB NO. ____

D.L. + PART L.L. + W.L.

(WIND FROM N-S & E-W)



DL + PART L.L. M (.75)

$M_1 = 179 \times \frac{1}{2} \times .75 = 67^{1K}$

$P_1 = 18 \times \frac{1}{2} \times .75 = 7^{K}$

$M_2 = 358 \times \frac{1}{2} \times .75 = 134^{1K}$

$P_2 = 7^{K}$

$M_3 = 598 \times \frac{1}{2} \times .75 = 224^{1K}$

$P_2 = 13 \times \frac{1}{2} \times .75 = 5^{K}$

NOTE: 1. BY INSPCT. DL. + LL CONTROLS RAFTER & COL.
2. COL BASE CONTROLED BY D.L. + PART L.L. + W.L.

FAA-STD-017

BY BK DATE ____ SUBJECT FAA NAT'L STD SHEET NO ____ OF ____

CHKD. BY ____ DATE ____ JOB NO ____

200F FRAMING

RAFTER

M = 358'' C

V = 13.2 K

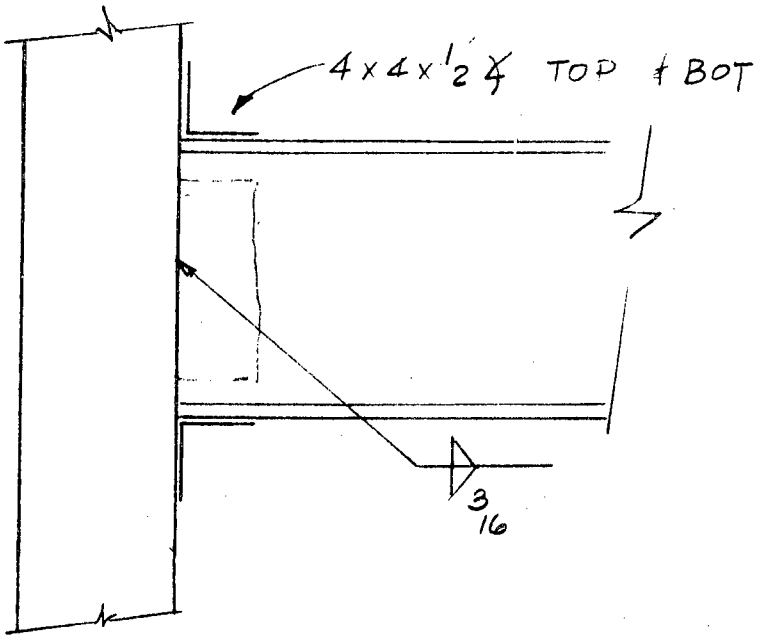
P = 2.2 K

14 at 34

$T = C = 358/14 = 25.6^{K}$

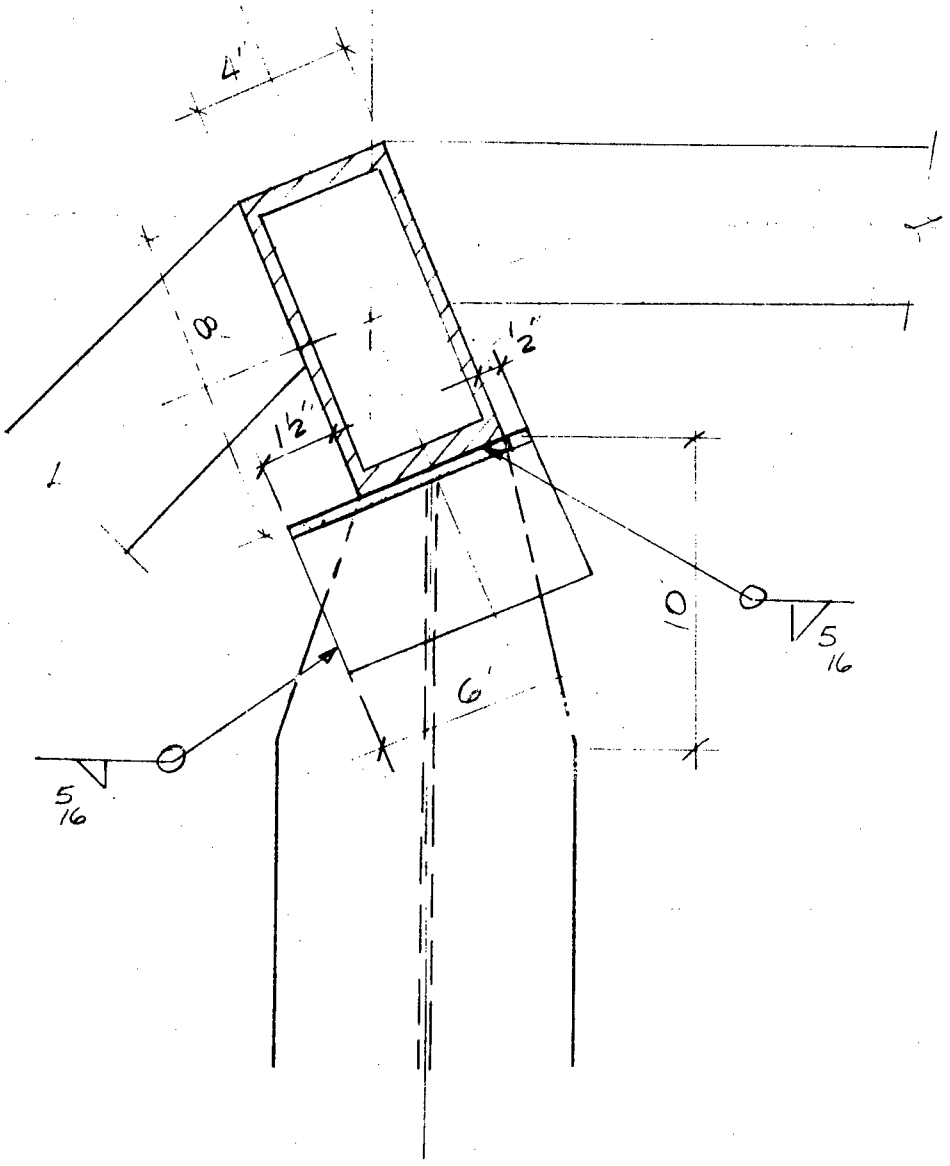
$A_{(FLG\ @\ COC)} = 4 \times \frac{7}{16} = 1.75^{\square''}$

$T_{allow} = C_{allow} = 1.75 \times 22 = 38.6^{K}$



BY RL DATE ____ SUBJECT L-2-S-5 SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ 8 SIDED LP JOB NO. ____



1175

FAA-STD-017

BY 3K DATE ____ SUBJECT FAA. NAT'L STD. SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ 8 SIDED CAB JOB NO. ____

COL BASE DETAIL

<D.L. + LL>

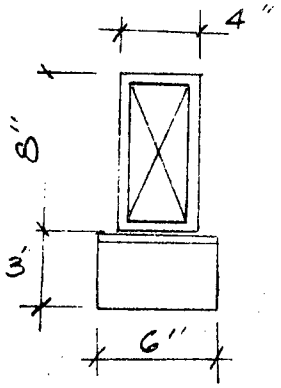
P = 18^K

M = 179"^K

V = 3^K

<D.L. + POST L.L. + W.L.>

P = 9^K
M = 313"^K
V = 3^K
} CONTROLS



P = T = 313/8 = 39.75^K

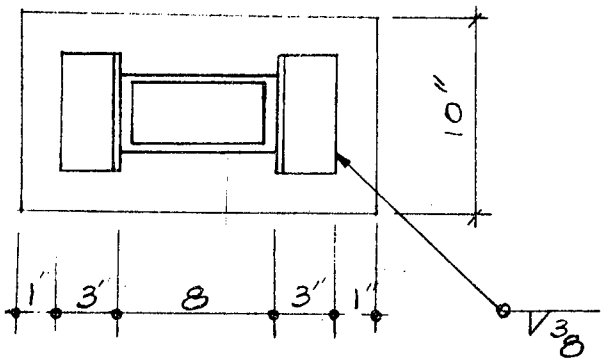
USE 3/8 WELD

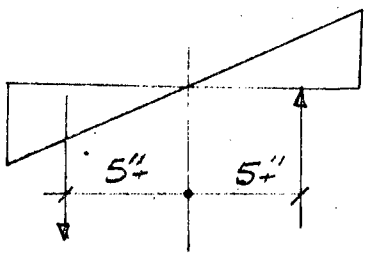
P_{ALLOW} = 4.8^K/in

ℓ_{REQD} = 39.75/4.8 = 8.3"

ℓ_{BCTOLL} = 4(TOP) + 4(SIDE) + 4(SIDE) = 12" OK (℄ TO COL)

ℓ_{LCTOLL} = 6 + 3 + 3 = 12" OK (℄ TO BASE PL)





M = 313"^K/10 = 31.3'^K/11

T = C = 31.3/10 = 3.13^K/11

f_c = 3130 × 2/8 = 780 PSI OK

P_{TOTAL} = 26^K

1185

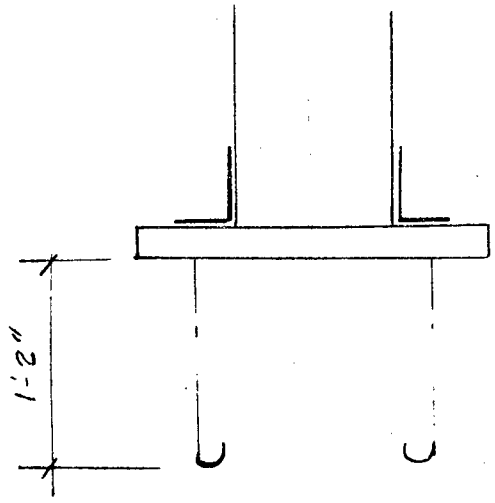
FAA-STD-017

BY BK DATE ____ SUBJECT FAA. NAT'L STD SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO. ____

8 SIDED CAB

BASE ℄ BENDING



$M = 26 \times 2.8 = 7.3^{k''}/_{ft}$

S_m 200 $= 7.3/_{27} = .27^{in^3}/_{in}$

USE $1\frac{1}{2}$" ℄

$10 \times 1\frac{1}{2} \times 1'-4"$

$T = C = 26^k$ USE 2-#8 DLCL.

USE STD HOOK

1195

FAA-STD-017

BY BK DATE ____ SUBJECT NATIONAL STD SHEET NO. ____ OF ____

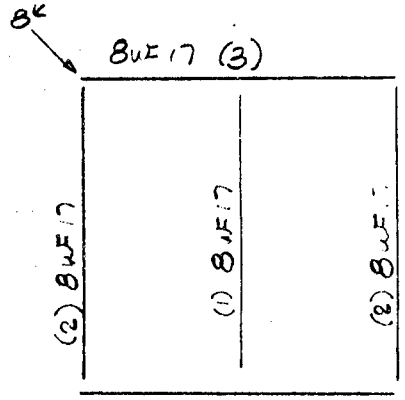
CHKD. BY ____ DATE ____ JOB NO. ____

8 SIDED CAB 200F

PENTHOUSE

200F	6.0 #/□'	
INSUL.	2.0	
DECK	3.0	
CEIL.	5.0	
MISC	4.0	
	20.0 #/□'	D.L.
	* 50.0 #/□'	L.L.
	70.0 #/□'	T.L.

* 60 PSF UPLIFT ON ROOF

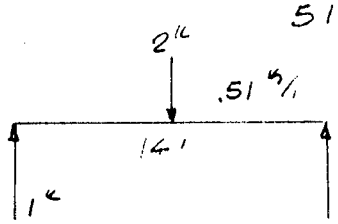


BM-1

w_T = 70 × 7 = 490 #/'

BM = 20

510 #/'



1K

3.1

4.1 K/'

M = 2 × 14/4 = 7.0

.51 × (14)²/8 = 12.5

19.5'K

USE 8WF17

BM-2

w_T = 3.5 × 70 = 245 #/' } .265 K/'

BM = 20 }

M = .3 × (14)²/8 = 7.4 'K

V = .3 × 14/2 = 2.1 K

USE 8WF17

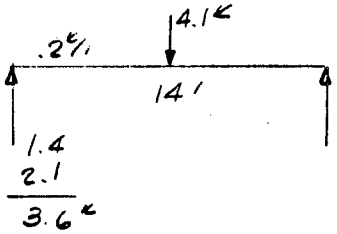
1205

FAA-STD-017

BY BK DATE | SUBJECT NATIONAL STD | SHEET NO. OF
CHKD. BY DATE | 8 SIDED CAB | JOB NO.

BM-3

$V = 2 \times 70 = 140$
$BM = 20$ } .16%, USE .2%



$M = 4.1K \; 14/4 = 14.3$
$.2 \times (14)^2/8 = 4.9$ } 19.1K

USE 8WF17

FAA-STD-017

Location
By GRS Date
Chkd. Appd.

Sheet No. 4M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

h_o	= .17
CELLULAR GLASS (SIMILAR)	= 5.12
ALUM SIDING (TWO SIDES)	= .02
h_i	= .61
ΣR	= 5.92

"U" = .17

EXPOSURE @ 8:00 AM
NORTH 8 X .17 = 1.3 BTU/SF
SOUTH 3 = .5
EAST 19 = 3.3
WEST 4 = .7

EXPOSURE @ 2:00 PM
NORTH 18 X .17 = 3.2 BTU/SF
SOUTH 31 = 5.3
EAST 20 = 3.4
WEST 20 = 3.4

EXPOSURE @ 4:00 PM
NORTH 21 X .17 = 3.4 BTU/SF
SOUTH 30 = 5.3
EAST 23 = 3.9
WEST 38 = 6.4

FAA-STD-017

Location

By GRS Date

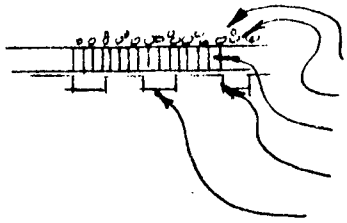
Chkd Appd.

Sheet No. 5M of

Job No.

Dwg. Ref.

Client W. BECKET Subject NAT'L STD AIR TRAFFIC CONTROL TOWER



h_o	.17
B.U ROOF	.33
1½ INS.	4.67
MET. DECK	0.0
h_i 15MPH R/A	.17
ER=	534
"U" =	.188

EXP @ 4:00PM

89 X 0.188 = 16.7

FAA-STD-017

Location
By GRS Date
Chkd Appd.

Sheet No. 6M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD AIR TRAFFIC CONTROL TOWER

COOLING ZONE A 96°FDB OSA 40° LAT
CAE GLASS HEAT GAIN FACTORS

EXPOSURE 3:00 PM APR 21

NORTH	26	+ (96-72).47	=	38 BTU/SF
SOUTH	83	+ 12	=	95 BTU/SF
EAST	26	+ 12	=	38 "
WEST	203	+ 12	=	215 "
NW	80	+ 12	=	92 "
SW	204	+ 12	=	216 "

EXPOSURE 4:00 PM APR 21

NORTH	22	+ 12	=	34 BTU/SF
SOUTH	41	+ 12	=	53 "
EAST	21	+ 12	=	33 "
WEST	225	+ 12	=	237 "
NW	128	+ 12	=	140 "
SW	189	+ 12	=	201 "

EXPOSURE 5:00PM APR 21

NORTH	16	+ 12	=	28 BTU/SF
SOUTH	16	+ 12	=	28 "
EAST	14	+ 12	=	26 "
WEST	201	+ 12	=	213 "
NW	141	+ 12	=	153 "
SW	143	+ 12	=	155 "

EXPOSURE 4:00PM JUNE 21

NORTH	29	+ 12	=	41 BTU/SF
SOUTH	29	+ 12	=	41 "
EAST	26	+ 12	=	38 "
WEST	215	+ 12	=	227 "
NW	156	+ 12	=	168 "
SW	152	+ 12	=	164 "

FAA-STD-017

Location
By GRS Date
Chkd Appd.
Client W. BECKET

Sheet No. 7M of
Job No.
Dwg. Ref.

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

COOLING ZONES B C & D 100°FDB OSA 32°LAT

CAB GLASS HEAT GAIN FACTORS

EXPOSURE	3:00 PM	APR 21
NORTH	28 + (100-72) 0.47 =	41 BTU/SF
SOUTH	58 + 13 =	71 BTU/SF
EAST	27 + 13 =	40 "
WEST	206 + 13 =	219 "
NW	103 + 13 =	116 "
SW	188 + 13 =	201 "

EXPOSURE	4:00 PM	APR 21
NORTH	23 + 13 =	36 BTU/SF
SOUTH	30 + 13 =	43 "
EAST	22 + 13 =	35 "
WEST	228 + 13 =	241 "
NW	144 + 13 =	157 "
SW	178 + 13 =	191 "

EXPOSURE	5:00 PM	APR 21
NORTH	17 + 13 =	30 BTU/SF
SOUTH	15 + 13 =	28 BTU/SF
EAST	14 + 13 =	27 BTU/SF
WEST	201 + 13 =	214 BTU/SF
NW	147 + 13 =	160 BTU/SF
SW	136 + 13 =	149

EXPOSURE	4:00 PM	JUNE 21
NORTH	36 + 13 =	49 BTU/SF
SOUTH	28 + 13 =	41 "
EAST	26 + 13 =	39 "
WEST	214 + 13 =	227 "
NW	135 + 13 =	148 "
SW	171 + 13 =	184 "

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Location

By GRS Date

Chkd Appd

Sheet No. 8M of

Job No.

Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

SHAFT WALL 'U' FACTOR

h_o	.17
12" CONC.	.96
h_i	.68
ΣR 1.81	"U" = 0.55

EXPOSURE 6:00 PM

NW	28 X .55	= 15
NE	32	= 18
SE	39	= 22
SW	36	= 20

EXPOSURE 4:00 PM

NW	22 X .55	= 12
NE	31	= 17
SE	38	= 21
SW	27	= 15

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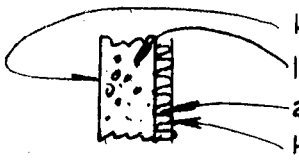
Location _____ Sheet No. 9M of _____

By GRS Date _____ Job No. _____

Chkd _____ Appd. _____ Dwg. Ref. _____

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

SHAFT WALL "U" FACTOR



h_o	.17
12" CONC.	.96
2" INS.	7.70
h_1	.68

$\Sigma R = 9.51$ "U" = 0.105

EXPOSURE 6:00 PM

NW 28 X.1 = 2.8
NE 32 = 3.2
SE 39 = 3.9
SW 36 = 3.6

EXPOSURE 4:00 PM

NW 22 X.1 = 2.2
NE 31 = 3.1
SE 38 = 3.8
SW 27 = 2.7

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Location

By GRS Date

Chkd Appd.

Sheet No. 10M of

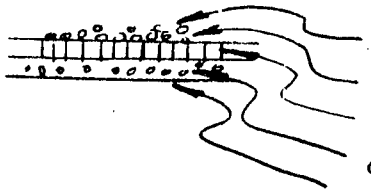
Job No.

Dwg. Ref.

Client W. BECKET

Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

MICROWAVE ROOF "U" FACTOR



h_o	.17
B.U. ROOF	.33
1" INS. BD	4.0
6" CONC. LT WT	6.66
h_i	.61
ΣR	11.77

"U" = .0855

4:00PM EXPOSURE

$79 \times .086 = 6.4$

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Location
By DWH Date
Chkd Appd.
Client W. BECKET

Sheet No. 11M of
Job No.
Dwg. Ref.

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

CAB HTG.

ZONE 1

GLASS : 112 X .47 = 53 BTU/SF
ROOF : 112 X .19 = 21
WALL : 112 X .17 = 19

ZONE 2

GLASS : 82 X .47 = 39 BTU/SF
ROOF : 82 X .19 = 15.5
WALL : 82 X .17 = 14

ZONE 3

GLASS : 67 X .47 = 31 BTU/SF
ROOF : 67 X .19 = 12.
WALL : 67 X .17 = 11

ZONE 4

GLASS : 52 X .47 = 24.5 BTU/SF
ROOF : 52 X .19 = 10
WALL : 52 X .17 = 8.8

Location
By DWH Date
Chkd Appd.

Sheet No. 12M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

JUNCTION RM. HTG.

ZONE 1.
WALL : 112 X .17 = 19 BTU/SF

ZONE 2
WALL : 82 X .17 = 14 BTU/SF

ZONE 3
WALL : 67 X .17 = 11.5 BTU/SF

ZONE 4
WALL : 52 X .17 = 8.8 BTU/SF

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Location
By PWH Date
Chkd Appd.

Sheet No. 13M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

CABLE, ELEV, & STAIR SHAFTS (NO INSUL.) HTG.

ZONE 1
WALL : 112 X .55 = 61.5 BTU/SF

ZONE 2
WALL : 82 X .55 = 45 BTU/SF

ZONE 3
WALL : 67 X .55 = 37 BTU/SF

ZONE 4
WALL : 52 X .55 = 28.5 BTU/SF

(2" INS) HTG.

ZONE 1
WALL : 112 X .1 = 11.2 BTU/SF

ZONE 2
WALL : 82 X .1 = 8.2

ZONE 3
WALL : 67 X .1 = 6.7

ZONE 4
WALL : 52 X .1 = 5.2

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Location_____ Sheet No. 53M of _____

By_____ Date_____ Job No._____

Chkd UWH Appd._____ Dwg. Ref._____

Client W/ BRICKET Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION FOUR REQ'D 4:00PM

ROOM NO. TYP. ANTENAE RM	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Class					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall 300#	6.4		1920		
Total Wall					
Roof 190#	6.4		1220		
Lights }					
PWR } 8.0KW x 3.4BTU/W			27000		
People					
ROOM SUBTOTALS			30140		
PLUS % S.T. & % W.U.					
ROOM TOTAL					
COOLING CFM 60 °FDB SUPPLY			1800		
HEATING SUPPLY TEMP. REQUIRED					

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Location
By DWH Date
Chkd Appd

Sheet No. 54-M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 1

ROOM NO. MICROWAVE TYP. ANT.		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall	300		168			5000
Roof	190		96			1830
Lights						
PWR						
People						
ROOM SUBTOTALS						6830
PLUS ___ % S.F. & ___ % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY						
HEATING SUPPLY TEMP. REQUIRED						

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Location

By PWH Date

Chkd Appd

Sheet No. 55M of

Job No.

Dwg. Ref.

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION ZONE 2

ROOM NO. MICROWAVE TYP. ANT.		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall	300		12			3600
Roof	190		7			1330
Lights						
PWR						
People						
ROOM SUBTOTALS						4930
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY						
HEATING SUPPLY TEMP. REQUIRED						

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Location
By PWH Date
Chkd Appd.

Sheet No. 56M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CA' CULATION ZONE 3

ROOM NO. MICROWAVE TYP. ANT.		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall	300		10			3000
Roof	190		5.8			1100
Lights						
PWR						
People						
						4100
ROOM SUBTOTALS						
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY						
HEATING SUPPLY TEMP. REQUIRED						

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Location

By D W H Date

Chkd Appd

Sheet No. 57M of

Job No.

Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFK CONTROL TOWER

ROOM LOAD CALCULATION ZONE 4

ROOM NO. MICROWAVE TYP. ANT.		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall	300		7.8			2340
Roof	190		4.5			860
Lights						
PWR						
People						
ROOM SUBTOTALS						3200
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY						
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 14M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

MICRO WAVE HTG

ZONE 1

WALL 2" F.G. : 112 X .15 = 16.8 BTU/SF

ZONE 2

82 X .15 = 12 BTU/SF

ZONE 3

67 X .15 = 10 BTU/SF

ZONE 4

52 X .15 = 7.8 BTU/SF

ZONE 1

ROOF 112 X .086 = 9.6 BTU/SF

ZONE 2

82 X .086 = 7.0

ZONE 3

67 X .086 = 5.8

ZONE 4

52 X .086 = 4.5

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Location
By DWH Date
Chkd Appd.

Sheet No. 15M of
Job No.
Dwg. Ref.

Client W. BECKET

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER
COOLING ZONE A
CLG R/A

ROOM LOAD CALCULATION

ROOM NO. EIGHT SIDED CAB 40°L		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL	67.5 □	3.4		230		
S PNL	67.5 □	5.3		358		
E PNL	67.5 □	3.9		263		
W PNL	67.5 □	6.4		432		
Total PNL	270 □					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof	790 □	16.7		13193		
Lights						
PWR						
People						
ROOM SUBTOTALS				14,476		
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY				670		
HEATING SUPPLY TEMP. REQUIRED						

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Location _____ Sheet No. 16M of _____

By DWH Date _____ Job No. _____

Chkd _____ Appd. _____ Dwg. Ref. _____

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE A

ROOM LOAD CALCULATION APR. 21 3:00 PM

ROOM NO. EIGHT SIDED CAB 40°L		C	H	SENSIBLE	LATENT	HEATING
NWGlass Sun	120 □	92		11040		
N Glass Shade	60 □	38		2280		
S Glass Sun	60 □	95		5700		
SEClass Shade	120 □	38		4560		
SWGlass Sun	120 □	216		25920		
E Glass Shade	60 □	38		2280		
W Glass Sun	60 □	215		12900		
NEGlass Shade	120 □	38		4560		
Total Glass	720 □					
N PNL	79 □	3.4		269		
S PNL	79 □	5.3		419		
E PNL	79 □	39		308		
W PNL	79 □	6.4		506		
Total PNL	318 □					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
Lights 790W X 3.4				2686		
PWR 10KW X 3.4				34000		
People 15				4125	4125	
ROOM SUBTOTALS				111,553	4125	
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				5430		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 17M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE A

ROOM LOAD CALCULATION APR. 21 4:00 PM

ROOM NO. EIGHT SIDED CAB 40°L		C	H	SENSIBLE	LATENT	HEATING
NWGlass Sun	120 ☐	140		16800		
N Glass Shade	60 ☐	34		2040		
S Glass Sun	60 ☐	53		3180		
SEGlass Shade	120 ☐	33		3960		
SWGlass Sun	120 ☐	201		24120		
E Glass Shade	60 ☐	33		1980		
W Glass Sun	60 ☐	237		14220		
NEGlass Shade	120 ☐	33		3960		
Total Glass	720 ☐					
N PNL	79 ☐	3.4		269		
S PNL	79 ☐	5.3		419		
E PNL	79 ☐	3.9		308		
W PNL	79 ☐	6.4		506		
Total PNL	318 ☐					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
Lights 7905F X 1W/SF X 3.4 BTH/W				26886		
PWR 10 KW X 3.4				34000		
People 15 X 275 S; 275 L				4125	4125	
ROOM SUBTOTALS				112,573	4125	
PLUS % S.T. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				5460		
HEATING SUPPLY TEMP. REQUIRED						

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Location_____ Sheet No. 18M of _____

By DWH Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE A

ROOM LOAD CALCULATION APR. 21 5:00 PM

ROOM NO. EIGHT SIDED CAB	40°L	C	H	SENSIBLE	LATENT	HEATING
NWGlass Sun	120 □	153		18360		
N Glass Shade	60 □	28		1680		
S Glass Sun	60 □	28		1680		
SEGlass Shade	120 □	26		3120		
SWGlass Sun	120 □	155		18600		
E Glass Shade	60 □	26		1560		
W Glass Sun	60 □	213		12780		
NEGlass Shade	120 □	26		3120		
Total Glass	720 □					
N PNL	79 □	3.4		269		
S PNL	79 □	5.3		419		
E PNL	79 □	3.9		308		
W PNL	79 □	6.4		506		
Total PNL	318 □					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
Lights 790 W X 3.4				2686		
PWR 10 KW X 3.4				34000		
People 15 X 275 S; 275L				4125	4125	
ROOM SUBTOTALS				103213	4125	
PLUS % S.T. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				5000		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 19M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE A

ROOM LOAD CALCULATION JUN. 21 4:00 PM

ROOM NO. EIGHT SIDED CAB 40°L		C	H	SENSIBLE	LATENT	HEATING
NWGlass Sun	120 □	168		20160		
N Glass Shade	60 □	41		2460		
S Glass Sun	60 □	41		2460		
SEGlass Shade	120 □	38		4560		
SWGlass Sun	120 □	164		19680		
E Glass Shade	60 □	38		2280		
W Glass Sun	60 □	227		13620		
NEGlass Shade	120 □	38		4560		
Total Glass	720 □					
N PNL	79 □	3.4		269		
S PNL	79 □	5.3		419		
E PNL	79 □	3.9		308		
W PNL	79 □	6.4		506		
Total PNL	318 □					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
Lights 790W X 3.4				2686		
PWR 10KW X 3.4				34000		
People 15 X 275S; 275L				4125	4125	
ROOM SUBTOTALS				112,093	4125	
PLUS % S.T. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				5450		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By OWH Date
Chkd Appd

Sheet No. 20M of
Job No.
Dwg. Ref.

Client W. BECKET

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE B C & D CLG R/A

ROOM LOAD CALCULATION

ROOM NO. EIGHT SIDED CAB 32°L		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL	67.5 □	3.4		230		
S PNL	67.5 □	5.3		358		
E PNL	67.5 □	3.9		263		
W PNL	67.5 □	6.4		432		
Total PNL	270 □					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof	790 □	16.7		13193		
Lights						
PWR						
Peop'e						
ROOM SUBTOTALS				14,976		
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY						
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 21M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE B C & D

ROOM LOAD CALCULATION APR. 21 3:00 PM

ROOM NO. EIGHT SIDED CAB 32'L		C	H	SENSIBLE	LATENT	HEATING
NW Glass Sun	120 □	116		13920		
N Glass Shade	60 □	41		2460		
S Glass Sun	60 □	71		4260		
SE Glass Shade	120 □	40		4800		
SW Glass Sun	120 □	201		24120		
E Glass Shade	60 □	40		2400		
W Glass Sun	60 □	219		13140		
NE Glass Shade	120 □	40		4800		
Total Glass	720 □					
N PNL	79 □	34		269		
S PNL	79 □	53		419		
E PNL	79 □	39		308		
W PNL	79 □	64		506		
Total PNL	318 □					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
Lights 790W X 3.4				2686		
PWR 10KW X 3.4				34000		
People 15 X 275 ; 275L				4125	4125	
ROOM SUBTOTALS				112,213	4125	
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				5460		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 22M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE B C & D

ROOM LOAD CALCULATION APR 21 4:00 PM

ROOM NO. EIGHT SIDED CAB 32°L		C	H	SENSIBLE	LATENT	HEATING
NW Glass Sun	120 ft	157		18840		
N Glass Shade	60 ft	36		2160		
S Glass Sun	60 ft	43		2580		
SE Glass Shade	120 ft	35		4200		
SW Glass Sun	120 ft	191		22920		
E Glass Shade	60 ft	35		2100		
W Glass Sun	60 ft	241		14460		
NE Glass Shade	120 ft	35		4200		
Total Glass	720 ft					
N PNL	79 ft	3.4		269		
S PNL	79 ft	5.3		419		
E PNL	79 ft	3.9		309		
W PNL	79 ft	6.4		506		
Total PNL	318 ft					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
Lights 790W X 3.4				2686		
PWR 10KW X 3.4				34000		
People 15 X 275S; 275L				4125	4125	
ROOM SUBTOTALS				113,774	4125	
PLUS ___ % S.F. & ___ % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				5520		
HEATING SUPPLY TEMP. REQUIRED						

FAA-STD-017

Location
By DWH Date
Chkd Appd.
Client W. BECKET

Sheet No. 23M of
Job No.
Dwg. Ref.

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE B C & D

ROOM LOAD CALCULATION JUN 21 4:00 PM

ROOM NO. EIGHT SIDED CAB 32°L		C	H	SENSIBLE	LATENT	HEATING
NW Glass Sun	120 ☐	148		17760		
N Glass Shade	60 ☐	49		2940		
S Glass Sun	60 ☐	41		2460		
SE Glass Shade	120 ☐	39		4680		
SW Glass Sun	120 ☐	184		22080		
E Glass Shade	60 ☐	39		2340		
W Glass Sun	60 ☐	227		13620		
NE Glass Shade	120 ☐	39		4680		
Total Glass	720 ☐					
N PNL	79 ☐	3.4		269		
S PNL	79 ☐	5.3		419		
E PNL	79 ☐	3.9		309		
W PNL	79 ☐	6.4		506		
Total PNL	318 ☐					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
Lights 790W x 3.4				2686		
PWR 10KW x 3.4				34000		
People 15 x 275S; 275L				4125	4125	
ROOM SUBTOTALS				112,874	4125	
PLUS % S.T. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				5450		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 24M of
Job No.
Dwg. Ref.

Client W. BECKET

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER COOLING ZONE B C & D

ROOM LOAD CALCULATION

APR. 21 5:00 PM

ROOM NO. EIGHT SIDED CAB 32°L		C	H	SENSIBLE	LATENT	HEATING
NW Glass Sun	120 □	160		19200		
N Glass Shade	60 □	30		1800		
S Glass Sun	60 □	28		1680		
SE Glass Shade	120 □	27		3240		
SW Glass Sun	120 □	149		17880		
E Glass Shade	60 □	27		1620		
W Glass Sun	60 □	201		12060		
NE Glass Shade	120 □	27		3240		
Total Glass	720 □					
N PNL	79 □	3.4		269		
S PNL	79 □	5.3		419		
E PNL	79 □	3.9		309		
W PNL	79 □	6.4		506		
Total PNL	318 □					
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
Lights 790 W X 3.4				2686		
PWR 10 KW X 3.4				34000		
People 15 X 275S; 275L				4125	4125	
ROOM SUBTOTALS				103,034	4125	
PLUS % S.T. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY				5010		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 25M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG. ZONE 1

ROOM NO. R/A CAB	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 270 ft		19			5150
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof 790 ft		21			16500
Lights					
PWR					
People					
ROOM SUBTOTALS					21650
PLUS ___ % S.F. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					105

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Location_____
By DWH Date_____
Chkd_____ Appd._____

Sheet No. 26M of _____
Job No._____
Dwg. Ref._____

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG. ZONE 2

ROOM NO. R/A CAB	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 270 □		14			3780
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof 790 □		15½			12000
Lights					
PWR					
People					
ROOM SUBTOTALS					15780
PLUS ____ % S.F. & ____ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					97

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Location

By DWH Date

Chkd Appd.

Sheet No. 27M of

Job No.

Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG. ZONE 3

ROOM NO. R/A CAB	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 270 sq		11			3000
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof 790 sq		12			9500
Lights					
PWR					
People					
ROOM SUBTOTALS					12500
PLUS ___ % S.F. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					92.3

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Location
By DWH Date
Chkd Appd.

Sheet No. 28M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 4

ROOM NO. R/A CAB	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 270		88			2380
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof 790		10			7900
Lights					
PWR					
People					
ROOM SUBTOTALS					10280
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					89.2

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Location
By DWH Date
Chkd Appd.

Sheet No. 29M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG. ZONE 1

ROOM NO. CAB.	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass 720 ft		53			38000
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 318 ft		19			6050
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					44050
PLUS ___ % S.F. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED AHU-2					83.3
" " " " AHU-1					79.5

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Location
By DWH Date
Chkd Appd.

Sheet No. 30M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG. ZONE 2

ROOM NO. CAB	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Class Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass 720 SQ FT		39			28000
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 318 SQ FT		14			4450
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					32450
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED AHU-2					80.4
" " " " AHU-1					77.5

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Location_____ Sheet No. 31M of _____

By DWH Date_____ Job No. _____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG. ZONE 3

ROOM NO. CAB	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass 720 BTU		31			22200
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 318 BTU		11			3500
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					25700
PLUS ___ % S.T. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					78.7
					76.3

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Location
By DWH Date
Chkd Appd.

Sheet No. 32M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NATL. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG. ZONE 4

ROOM NO. CAB	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass 720 ft²		24			17,200
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 318 ft²		88			2820
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					20020
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					77.2
					75.4

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Location
By GRS Date
Chkd Appd.

Sheet No. 33M of
Job No.
Dwg. Ref.

Client W. BECKET

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION 4:00PM

ROOM NO. JUNCTION RM		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL	64 □	3.4		217		
S PNL	64 □	5.3		339		
E PNL	64 □	3.9		250		
W PNL	64 □	6.4		410		
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof						
	5HP X 2544 BTU/HP			12720		
Lights	1200 X 3.4 BTU/W			4095		
PWR	5KW X 3.4 BTU/W			17065		
People	2 X 275S; 275L			550	550	
ROOM SUBTOTALS				35646	550	
PLUS ___ % S.F. & ___ % W.U.						
ROOM TOTAL						
COOLING CFM	°FDB SUPPLY			1650		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 34M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 1

ROOM NO. JUNCTION	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 256 □		19			4850
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					4850
PLUS % S.T. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					77.7

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Location
By DWH Date
Chkd Appd

Sheet No. 35M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION ZONE 2

ROOM NO. JUNCTION	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 256□		14			3600
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					3600
PLUS ___ % S.F. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					77.0

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Location
By RWH Date
Chkd Appd.

Sheet No. 36M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 3

ROOM NO. JUNCTION	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Class Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Class					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 256 ft²		11.5			2960
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					2960
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					76.8

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Location
By DWH Date
Chkd Appd.

Sheet No. 37M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 4

ROOM NO. JUNCTION	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL 256		88			2250
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					2250
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					76.2

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Location
By DWH Date
Chkd Appd.

Sheet No. 38M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER 180' TOWER 2" INSULATION 4:00PM

ROOM LOAD CALCULATION

ROOM NO. CABLE CHASE			C	H	SENSIBLE	LATENT	HEATING
N Glass Sun							
N Glass Shade							
S Glass Sun							
S Glass Shade							
E Glass Sun							
E Glass Shade							
W Glass Sun							
W Glass Shade							
Total Glass							
N PNL							
S PNL							
E PNL							
W PNL							
Total PNL							
Wall	NW	1575 ft	2.2		3500		
Wall	NE	1575 ft	3.1		4900		
Wall	SE	1575 ft	3.8		6000		
Wall	SW	1725 ft	27		4250		
Total Wall		6450 ft					
Roof							
Lights	500W x 3.4 BTU/W				1700		
PWR							
People	1X250 S; 250 L				250	250	
ROOM SUBTOTALS					20600	250	
PLUS % S.F. & % W.U.							
ROOM TOTAL							
COOLING CFM °FDB SUPPLY					950		
HEATING SUPPLY TEMP. REQUIRED							

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Location_____ Sheet No. 39M of _____

By DWH Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER 150' TOWER

ROOM LOAD CALCULATION 4:00PM

ROOM NO. CABLE, ELEV., & STAIR SHAFTS	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
COOLING & HTG. LOADS					
FOR 150' TOWER ARE 83.5%					
OF 180' TOWER FOR ALL CONDITIONS					
Lights					
PWR					
People					
ROOM SUBTOTALS					
PLUS ____ % S.T. & ____ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					

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Location
By DWH Date
Chkd. Appd.
Client W. BECKET

Sheet No. 40M of
Job No.
Dwg. Ref.

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER 120' TOWER

ROOM LOAD CALCULATION

ROOM NO. SHAFTS	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall					
Roof					
COOLING & HTG LOADS					
FOR 120' TOWER ARE 67.07%					
OF 180' TOWER FOR ALL CONDITIONS					
Lights					
PWR					
People					
ROOM SUBTOTALS					
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					

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Location
By GRS Date
Chkd Appd

Sheet No. 41M of
Job No.
Dwg. Ref.

Client W. BECKET

Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER 180' TOWER NO INSULATION 4:00PM

ROOM LOAD CALCULATION

ROOM NO. CABLE CHASE		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
Wall	NW 1575 □	12		18900		
Wall	NE 1575 □	17		26800		
Wall	SE 1575 □	21		33000		
Wall	SW 1725 □	15		23500		
Total Wall	6450 □					
Roof						
Lights	500W x 3.4 BTU/W			1700		
PWR						
People	1 X 250 S; 250 L			250	250	
ROOM SUBTOTALS				104150	250	
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY				4800		
HEATING SUPPLY TEMP. REQUIRED						

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Location_____
By DAW Date_____
Chkd_____ Appd._____

Sheet No. 42M of_____
Job No._____
Dwg. Ref._____

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER 180' TOWER

ROOM LOAD CALCULATION 2" INSULATION 4:00PM

ROOM NO. ELEVATOR			C	H	SENSIBLE	LATENT	HEATING
N Glass Sun							
N Glass Shade							
S Glass Sun							
S Glass Shade							
E Glass Sun							
E Glass Shade							
W Glass Sun							
W Glass Shade							
Total Glass							
N PNL							
S PNL							
E PNL							
W PNL							
Total PNL							
Wall	NW	1575 □	2.2		3500		
Wall	NE	1575 □	3.1		4900		
Wall	SE	1575 □	3.8		6000		
Wall	SW	1725 □	2.7		4250		
Total Wall		6450 □					
Roof							
Lights	3000W x 3.4BTU/W				10200		
PWR							
People	5X250 S & 250L				1250	1250	
ROOM SUBTOTALS					30100	1250	
PLUS % S.F. & % W.U.							
ROOM TOTAL							
COOLING CFM °FDB SUPPLY					1410		
HEATING SUPPLY TEMP. REQUIRED							

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Location
By DWH Date
Chkd Appd

Sheet No. 43M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER 180' TOWER NO INSULATION 4:00PM

ROOM LOAD CALCULATION

ROOM NO. ELEVATOR		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Shade						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
Wall NW	1575 □	12		18900		
Wall NE	1575 □	17		26800		
Wall SE	1575 □	21		33000		
Wall SW	1725 □	15		23500		
Total Wall	6450 □					
Roof						
Lights 3000W x 3.4BTU/W				10200		
PWR						
People 5 X 250S;250L				1250	1250	
ROOM SUBTOTALS				113650	1250	
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY				5200		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

Sheet No. 44M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 1 NO INSUL 180' TOWER

ROOM NO. CABLE, ELEV., & STAIR SHAFT	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall 6450 ft		615			400,000
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					400,000
PLUS . % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					152

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Location
By OWH Date
Chkd Appd.

Sheet No. 4.5M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 2

ROOM NO. CABLE ELEV & STAIR	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall 6450 ft²		45			290,000
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					290,000
PLUS % S.T. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					131

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Location
By PWH Date
Chkd Appd.

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Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 3 NO INSUL

ROOM NO. CABLE ELEV & STAIR	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall 6450#		37			238000
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					238000
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					121

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Location_____ Sheet No. 47M of _____

By DWH Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 4

ROOM NO. CABLE ELEV & STAIR SHAFT	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall 6450 ft²		28			184000
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					184000
PLUS ___ % S.F. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					110.5

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Location
By DWH Date
Chkd Appd

Sheet No. 48M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 1 2" INSULATION 180' TOWER

ROOM NO. CABLE, ELEV. & STAIR SHAFT	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall 6450 ft		H			71500
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					71500
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					145

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Location _____ Sheet No. 4.9M of _____

By DWH Date _____ Job No. _____

Chkd _____ Appd. _____ Dwg. Ref. _____

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 2

ROOM NO.	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Class Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall 6450 ft		82			53000
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					53000
PLUS ___ % S.F. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					128

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Location
By LWH Date
Chkd Appd.

Sheet No. 50M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 3

ROOM NO.	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall 6450 ☐		6.7			43200
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					43200
PLUS ___ % S.F. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					117

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Location_____ Sheet No. 51M of _____

By DWH Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject NAT'L STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION HTG ZONE 4

ROOM NO.	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall					
E Wall					
W Wall					
Total Wall 6450 FA		52			33,500
Roof					
Lights					
PWR					
People					
ROOM SUBTOTALS					33500
PLUS ___ % S.F. & ___ % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					
					108

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Location _____ Sheet No. 5211 of _____

By DWH Date _____ Job No. _____

Chkd _____ Appd. _____ Dwg. Ref. _____

Client W. BECKET Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION BLOCK 4:00PM

ROOM NO. MICROWAVE LEVEL		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL	640 □	3.4		2176		
S PNL	640 □	5.3		3392		
E PNL	640 □	3.9		2496		
W PNL	640 □	6.4		4096		
Total PNL	2560 □					
N URETHANE PNL	210 □	4.8		1000		
S	210 □	7.6		1600		
E	210 □	5.1		1050		
W	210 □	10		2100		
Total Wall	840 □					
Roof	1680 □	6.4		10752		
Lights 8KW X 3.4BTU/W				27,304		
PWR 25KW X 3.4				85,325		
People 2 @ 275S ; 275L				550	550	
ROOM SUBTOTALS				140941	550	
PLUS % S.T. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY				6450		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By DWH Date
Chkd Appd.

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Job No.
Dwg. Ref.

Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

5460 CFM AHU-1 C

600 CFM POTA @ 53°FDB / 52.0°FWB
BASED ON 20 PEOPLE & 30 CFM/PERSON

COOLING CYCLE (ZONE A)

R/A TEMP = 72°F + JUNCTION RM. + ROOF - PTOA

$$= 72 + \frac{35646 + 14,476}{5460 \times 1.08} - \frac{600}{5460} \times 19$$

$$= 72 + 8.5 - 2.1$$

ZONE A = 78.4°FDB / 62.2°FWB

COIL LEAVING = 53°FDB / 52°FWB

COIL SEN. = 5460 x 1.08 x (78.4 - 53)
= 150,000 BTU/HR

ZONE A COIL LAT. = 5460 x 0.68 x 2
= 7500 BTU/HR

COIL TOTAL = 157,500 BTU/HR

COIL GPM = 36.5

2" PIPE

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Location

By PWH Date

Chkd Appd.

Sheet No. 5 911 of

Job No.

Dwg. Ref.

Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

HEATING CYCLE (ZONE 1) AHU-1

R/A TEMP = 72° − JUNCTION RM - ROOF - PTOA

$$= 72 - \frac{(4{,}850 + 21{,}650)}{5460 \times 1.08} - \frac{600}{5460} \times 32$$

$$= 72 - 4.5 - 3.5$$

$$= 64.0°F$$

TEMP REQ'D FOR HEATING = 79.5

HEATING CAP = 5460 × 1.08 (79.5 − 64.0)

= 91,000 BTU/HR

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Location
By DWH Date
Chkd Appd.
Client W. BECKET

Sheet No. 6 OM of
Job No.
Dwg. Ref.

Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

AHU-1

5520 CFM
600 CFM PTOA

COOLING CYCLE (ZONE B, C, D)

R/A TEMP = 72°F + JUNCT. RM + ROOF - PTOA

$= 72° + \frac{35,646 + 14,476}{5520 \times 1.08} - \frac{600}{5520} \times 19$

$= 72° + 8.3 - 2.6$

$= 77.7$ °FDB / 62.0 WB

COIL LVG = 53°FDB / 52°FWB

COIL SEN. = $5520 \times 1.08 (77.7 - 53.0)$
= 148,000 BTU/HR

COIL LAT. = $5520 \times .68 \times 2$ = 7,500

COIL TOT. = 155,500 "

COIL GPM = 32.
2" PIPE

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Location
By DWH Date
Chkd Appd

Sheet No. 6 of 19
Job No.
Dwg. Ref.

Client W BECKET Subject NAT'L. STD AIR TRAFFIC CONTROL TOWER

HTG CYCLE (ZONE 2) 5520 CFM

R/A = 72 - JUNCT. RM - ROOF - PTOA

$= 72 - \left(\frac{3600 + 15780}{5520 \times 1.08}\right) - \frac{600}{5520} \times 32$

$= 72 - 3.8 - 3.5$

$= 64.7$

HTG CAP $= 5520 \times 1.08 \times (77.5 - 64.7)$

$= 76{,}000$ BTU/HR

(ZONE 3)

$R/A = 72 - \left(\frac{2960 + 12500}{5520 \times 1.08}\right) - \frac{600}{5520} \times 32$

$= 72 - 2.6 - 3.5$

$= 65.9$

HTG CAP $= 5520 \times 1.08 \times (76.3 - 65.9)$

$= 62{,}000$ BTU/HR

(ZONE 4)

$R/A = 72 - \left(\frac{2250 + 10{,}280}{5520 \times 1.08}\right) - \frac{600}{5520} \times 32 = 66.4$

$HTG = 5520 \times 1.08 \times (75.4 - 66.4) = 53{,}500 \frac{BTU}{HR}$

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Location_____ Sheet No. 6 2M of _____

By DWH Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W BUCKET Subject AHU-1

FAN STATIC PRESSURE CALCULATION:

MARK	DUCT SIZE"	CFM	STRAIGHT LENGTH FT.	FITTINGS EQ. LENGTH FT.	TOTAL EQ. LENGTH FT.	FRICTION RATE "/100'	VELOCITY FPM	VELOCITY HEAD "	OTHER	LOSS OR GAIN
		5150							R/A	0.10
									FILTERS FG	0.35
									CH COIL	0.96
									DX ↓	0.53
									HW ↓	0.26
									APARATUS	0.10
									CARBON FILTERS	0.15
									DIRT	0.10
	60X14	6200							ELECT. DUCT FURN.	0.15
	60X14	6200	15	70	85	.06	1300	NEG		0.05
	36X14	3100	5	15	20	.05				0.01
	30X14	2400	5	15	↓	.05				↓
	24X14	1800	5	15		.04				
	24X12	1200	5	15		.04				0.00
	18X12	600	5	10	15	.02			DIFF.	0.15
										2.94
									SPECIFY	3.00

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Location
By DWH Date
Chkd Appd.
Client W. BECKET Subject AHU-2

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Job No.
Dwg. Ref.

FAN STATIC PRESSURE CALCULATION:

MARK	DUCT SIZE"	CFM	STRAIGHT LENGTH FT.	FITTINGS EQ. LENGTH FT.	TOTAL EQ. LENGTH FT.	FRICTION RATE "/100'	VELOCITY FPM	VELOCITY HEAD "	OTHER	LOSS OR GAIN
		3100							R/A	0.10
									F.G. FILTERS	0.35
									CARBON "	0.40
									HW COIL	0.26
									APARATUS	0.10
	24x20	3100	10	30	40	.06				0.02
	24x10	1550	40	45	85	.06				0.04
	8"Φ	260	FLEX.		30	.16			X 10 CORR. FACT.	0.48
									DIFF	0.30
										2.07
									SPECIFY	2.10

Location
By DWH Date
Chkd Appd.
Client W. BECKET Subject ACC-1 AIR COOLED CONDENSER

Sheet No. 64M of
Job No.
Dwg. Ref.

FAN STATIC PRESSURE CALCULATION:

MARK	DUCT SIZE"	CFM	STRAIGHT LENGTH FT.	FITTINGS EQ. LENGTH FT.	TOTAL EQ. LENGTH FT.	FRICTION RATE "/100'	VELOCITY FPM	VELOCITY HEAD "	OTHER	LOSS OR GAIN
		11000							OSA	0.15
		11000							DISCH.	0.25
									6 ROW COIL	1.25
										1.65

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Location
By RWH Date
Chkd Appd.

Sheet No. 6.5M.4
Job No.
Dwg. Ref.

Client W. BECKET Subject F-1 CAB EMERG. VENT.

FAN STATIC PRESSURE CALCULATION:

MARK	DUCT SIZE"	CFM	STRAIGHT LENGTH FT.	FITTINGS EQ. LENGTH FT.	TOTAL EQ. LENGTH FT.	FRICTION RATE "/100'	VELOCITY FPM	VELOCITY HEAD"	OTHER	LOSS OR GAIN
									OSA	0.15
									R/A	0.15
									DISCH	0.10
									½ 3000 FPM	
									.57X.75	0.43
										0.83

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Location
By DWH Date
Chkd Appd.

Sheet No. 66M of
Job No.
Dwg. Ref.

Client W. BECKET Subject F-2 JUNCT. TOILET EXH.

FAN STATIC PRESSURE CALCULATION:

MARK	DUCT SIZE"	CFM	STRAIGHT LENGTH FT.	FITTINGS EQ. LENGTH FT.	TOTAL EQ. LENGTH FT.	FRICTION RATE "/100'	VELOCITY FPM	VELOCITY HEAD "	OTHER	LOSS OR GAIN
		150							12X6 REG-E	0.10
	12X6	150	2	10	12	0.02				0.01
	8X8	300	10	10	20	0.08				0.02
									SPECIFY 0.25	

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Location_____ Sheet No. 67M of _____

By DWH Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W BECKET Subject F-3 MICROWAVE LEVEL BATTERY EXH.

FAN STATIC PRESSURE CALCULATION:

MARK	DUCT SIZE"	CFM	STRAIGHT LENGTH FT.	FITTINGS EQ. LENGTH FT.	TOTAL EQ. LENGTH FT.	FRICTION RATE "/100'	VELOCITY FPM	VELOCITY HEAD "	OTHER	LOSS OR GAIN
									CABINET	.10
	12X12	1000	20	30	50	0.13				0.07
									LOUVER	0.10
										0.27
									SPECIFY .25	

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Location _____ Sheet No. 68M of _____

By PWH Date _____ Job No. _____

Chkd _____ Appd. _____ Dwg. Ref. _____

Client W. BECKET Subject F-4 MICROWAVE EMERG. VENT.

FAN STATIC PRESSURE CALCULATION: F-5 SIMILAR

MARK	DUCT SIZE"	CFM	STRAIGHT LENGTH FT.	FITTINGS EQ. LENGTH FT.	TOTAL EQ. LENGTH FT.	FRICTION RATE "/100'	VELOCITY FPM	VELOCITY HEAD "	OTHER	LOSS OR GAIN
		4000							OSA INTAKE	0.20
		4000		-					DISCH LOUVER	0.18
									FILTERS	0.20
		4000							MOD	0.4
										0.80

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Location

By GRS Date

Chkd Appd.

Sheet No. 69M of

Job No.

Dwg. Ref.

Client W. BECKET Subject NATL STD AIR TRAFFIC CONTROL TOWER COOLING ZONE A

ROOM LOAD CALCULATION APR21 4PM

ROOM NO. C-2 CAB		C	H	SENSIBLE	LATENT	HEATING
NW Glass Sun	71	140		9940		
N Glass Shade	142	34		4838		
S Glass Sun	71	53		3763		
SW Glass ~~Shade~~ SUN	71	201		14250		
E Glass Sun						
E Glass Shade	242	33		7976		
W Glass Sun	142	237		33680		
W Glass Shade						
Total Glass						
N PNL	79	3.4		269		
S PNL	79	5.3		419		
E PNL	79	3.9		308		
W PNL	79	6.4		506		
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof	700	16.7		11,690		
Lights						
PWR 10 KW x 3.4				34000		
People 15 x 275 S; 275 L				4125	4125	
ROOM SUBTOTALS				125,764		
PLUS ___ % S.F. & ___ % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				6120		
HEATING SUPPLY TEMP. REQUIRED						

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Location

By GRS Date

Chkd Appd

Sheet No. 70M of

Job No.

Dwg. Ref.

Client W. BECKET Subject NATL STD AIR TRAFFIC CONTROL TOWER

COOLING ZONE B, C, & D

APR 21 4PM

ROOM LOAD CALCULATION

ROOM NO. C-2 CAB		C	H	SENSIBLE	LATENT	HEATING
NW Glass Sun	71	157		11,130		
N Glass Shade	142	36		5110		
S Glass Sun	71	43		3050		
SW Glass ~~Shade~~ Sun	71	191		13580		
E Glass Sun						
E Glass Shade	242.	35		8470		
W Glass Sun	142	241		34200		
W Glass Shade						
Total Glass	781					
N PNL	79	3.4		269		
S PNL	79	53		419		
E PNL	79	3.9		308		
W PNL	79	6.4		506		
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof	700	16.7		11,690		
Lights						
PWR	10KW X 3.4			34000		
People	15 x 275s ; 275l			4125	4125	
ROOM SUBTOTALS				126,857		
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				6150		
HEATING SUPPLY TEMP. REQUIRED						

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Location
By GRS Date
Chkd Appd.

Sheet No. 71M of
Job No.
Dwg. Ref.

Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

AHU-3 COOLING ZONE A, B, C, D,

6150 CFM TOTAL 600 CFM PTOA

JUNCTION LEVEL FINAL

$$\text{TEMP} = 72°\text{FDB} + \frac{35,646}{6150 \times 1.08} = 72 + 5.4$$

$$= 77.4°\text{FDB}$$

$$\text{COIL ENT} = 77.4 - \frac{600}{6150} \times 19 = 77.4 - 1.9 = 75.5$$

$$= 75.5°\text{FDB} / 60.8°\text{FWB}$$

$$\text{COIL SEN} = 6150 \times 1.08 \times (75.5 - 53) = 149,000$$

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Location

By SRS Date

Chkd Appd

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Job No.

Dwg. Ref.

Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TWR

ROOM LOAD CALCULATION COOLING ZONE A HEATING ZONE 1 4:00PM

ROOM NO. BASE LEVEL LOBBY		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun SKYLIGHT	50 □	154		7700		
N Glass Shade SKYLIGHT	50 □	40		2000		
S Glass Sun SKYLIGHT	100 □		120			12000
S Glass Shade	64 □	37		2350		
E Glass Sun						
E Glass Shade	64 □	31		2000		
W Glass Sun	64 □	137		8700		
W Glass Shade	64 □	36		2300		
Total Glass	256 □		120			30500
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof	477 □	8.9	130			6200
Lights 2000W X 3.4 BTU/W				6,800		
PWR						
People 15 X 250 ; 200L				3750	3000	
ROOM SUBTOTALS				39,820	3,000	48,700
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				2000		
HEATING SUPPLY TEMP. REQUIRED						

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By DWH Date _____ Job No. _____

Chkd _____ Appd. _____ Dwg. Ref. _____

Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

COOLING ZONE B

ROOM LOAD CALCULATION HEATING ZONE 2

ROOM NO. BASE LEVEL LOBBY		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun SKYLIGHT	50 □'	154		7700		
N Glass Shade SKYLIGHT	50 □'	40		2000		
S Glass Sun SKYLIGHT	100 □'		87			8700
S Glass Shade	64 □'	45		2900		
E Glass Sun						
E Glass Shade	64 □'	39		2500		
W Glass Sun	64 □'	139		8900		
W Glass Shade	64 □'	43		2750		
Total Glass	256 □'		87			22000
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof	477 □'	8.9	9.4	4250		4500
Lights 2000 W x 3.4 BTU/W				6800		
PWR						
People 15 x 250 S; 200 L				3750	3000	
ROOM SUBTOTALS				41,550	3000	35200
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				2000		
HEATING SUPPLY TEMP. REQUIRED						

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Location

By DAVE Date

Chkd Appd.

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Job No.

Dwg. Ref.

Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION

COOLING ZONE C
HEATING ZONE 3

ROOM NO. BASE LEVEL LOBBY		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun	SKYLIGHT 50 ☐	154		7700		
N Glass Shade	SKYLIGHT 50 ☐	40		2000		
S Glass Sun	SKYLIGHT 100 ☐		69			6900
S Glass Shade	64 ☐	45		2900		
E Glass Sun						
E Glass Shade	64 ☐	39		2500		
W Glass Sun	64 ☐	139		8900		
W Glass Shade	64 ☐	43		2750		
Total Glass	256 ☐		69			17500
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof	477 ☐	89	77	4250		3660
Lights 2000 x 3.4				6800		
PWR						
People 15				3750	3000	
ROOM SUBTOTALS				41550	3000	28060
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				2000		
HEATING SUPPLY TEMP. REQUIRED						

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By DWJH Date
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Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION

COOLING ZONE D
HEATING ZONE 4

ROOM NO. BASE LEVEL LOBBY		C	H	SENSIBLE	LATENT	HEATING
N Glass Sun	SKYLIGHT 50 □	154		7700		
N Glass Shade	SKYLIGHT 50 □	40		2000		
S Glass Sun	SKYLIGHT 100 □		55			5500
S Glass Shade	64 □	45		2900		
E Glass Sun						
E Glass Shade	64 □	39		2500		
W Glass Sun	64 □	139		8900		
W Glass Shade	64 □	43		2750		
Total Glass	256 □		55			14000
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall						
Roof	477 □	89	6.0	4250		2850
Lights 2000W X 3.4BTU/W				6800		
PWR						
People 15X250 & 200L				3750	3000	
ROOM SUBTOTALS				41550	3000	22350
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM 53 °FDB SUPPLY				2000		
HEATING SUPPLY TEMP. REQUIRED						

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Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

FAN STATIC PRESSURE CALCULATION: AHU-3

MARK	DUCT SIZE"	CFM	STRAIGHT LENGTH FT.	FITTINGS EQ. LENGTH FT.	TOTAL EQ. LENGTH FT.	FRICTION RATE "/100'	VELOCITY FPM	VELOCITY HEAD "	OTHER	LOSS OR GAIN
									R/A	0.10
									F.G. FILTERS	0.35
									APARATUS	0.20
									CH COIL	0.96
									CARBON FILTERS	0.90
	38X14	3100	30	90	120	.05				.06
	8" ϕ	500	10			2.0			8"ϕ FLEX	.20
									SLOT DIFFUSER	.30
										3.07
									SPECIFY	3.10

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Client V/ BECHTEL Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION SUB-JUNCTION LEVEL

ROOM NO. 7 CORRIDOR	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall 115	5.3		610		
E Wall					
W Wall 115	6.4		736		
Total Wall 230		19			4310
Roof					
FLOOR 260		21			5460
Lights 800 X 3.413			2730		
PWR					
People 4@ 250S & 250L			1000	1000	
ROOM SUBTOTALS			5076	1000	9830
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					

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Client W. BECKET

Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION

ROOM NO. 8 ELECT CLOSET	C	H	SENSIBLE	LATENT	HEATING
N Glass Sun					
N Glass Shade					
S Glass Sun					
S Glass Shade					
E Glass Sun					
E Glass Shade					
W Glass Sun					
W Glass Shade					
Total Glass					
N PNL					
S PNL					
E PNL					
W PNL					
Total PNL					
N Wall					
S Wall 115	5.3		610		
E Wall					
W Wall 115	6.4		736		
Total Wall 230		19			4370
Roof					
FLOOR 140		21			2940
Lights					
PWR 2000 X 3.413			6826		
People					
ROOM SUBTOTALS			7772		7310
PLUS % S.F. & % W.U.					
ROOM TOTAL					
COOLING CFM °FDB SUPPLY					
HEATING SUPPLY TEMP. REQUIRED					

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Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION SUB-JUNCT. LEVEL ZONE 2 ZONE 3 ZONE 4

ROOM NO. BLOCK	H	H	H	SENSIBLE	LATENT	HEATING
N Glass Sun	2	3	4			
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall 460	14	11	88	6440	5060	4048
Roof						
FLOOR 400	155	12	10	6200	4800	4000
Lights						
PWR						
People						
ROOM SUBTOTALS				12640	9860	8048
PLUS ____ % S.F. & ____ % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY						
HEATING SUPPLY TEMP. REQUIRED						

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Client W. BECKET

Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION

ZONE 2 ZONE 3 ZONE 4

ROOM NO. 7 CORRIDOR	H	H	H	SENSIBLE	LATENT	HEATING
N Glass Sun						
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall 230	14	11	8.3	3220	2530	2024
Roof						
FLOOR 260	16.5	12	10	4030	3120	2600
Lights						
PWR						
People						
ROOM SUBTOTALS				7250	5650	4624
PLUS % S.F. & % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY						
HEATING SUPPLY TEMP. REQUIRED						

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By GRS Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject NAT'L STANDARD AIR TRAFFIC CONTROL TOWER

ROOM LOAD CALCULATION

ROOM NO. 8 ELECT. CLOSET	H	H	H	SENSIBLE	LATENT	HEATING
N Glass Sun	2	3	4			
N Glass Shade						
S Glass Sun						
S Glass Shade						
E Glass Sun						
E Glass Shade						
W Glass Sun						
W Glass Shade						
Total Glass						
N PNL						
S PNL						
E PNL						
W PNL						
Total PNL						
N Wall						
S Wall						
E Wall						
W Wall						
Total Wall 230	14	11	88	3220	2530	2024
Roof						
FLOOR 140	155	12	10	2170	1680	1400
Lights						
PWR						
People						
ROOM SUBTOTALS				5390	4210	3424
PLUS ____ % S.F. & ____ % W.U.						
ROOM TOTAL						
COOLING CFM °FDB SUPPLY						
HEATING SUPPLY TEMP. REQUIRED						

FOR TOWER WITH OUT MICROWAVE - THIS SHEET TO BE USED IN LIEU OF THE SHEET 4E

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By BWS Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject_____

DISTRIBUTION PNL "DPT1" ESSENTIAL POWER

CKT.	DESCRIPTION	LOAD IN KVA
1A	LIGHTING	3.6
1	LIGHTING	3.6
2	PNL "RPT2"	15.0
3	LIGHTING	1.0
4	PNL "RPT2"	0
5	LIGHTING	2.
6		1.4
7		2.4
	TOTAL LOAD	29.0 KVA

LOAD BASED ON FAA-ER-440-029 CRITERIA

FEEDER SIZE:

a) LOAD $\frac{29.0\text{KVA}}{480 \times 1.73} = 35\text{A}$

b) WIRE SIZE: 35A X 1.25 = 43A USE 4#1/0, 2"C

c) FEEDER BKR. SIZE: 150A, 3P (PARALLEL)

d) PANEL MAIN BKRS: 125A, 3P

e) PANEL TIE BKR: 100A, 3P

f) PANEL MAINS: 225A

g) TRANSFORMER #TT1 & #TT2 SHALL BE 30KVA EA. WITH 50A, 3P BKR, 4#8, 1"C PRIMARY AND 4#2, 2"C SECONDARY.

h) VOLTAGE DROP CALCULATION: BASED ON SIMPLEX METHOD;

FEED LENGHT (250'), LOAD (35A), Z = .108 FOR #1/0

$V_d = \frac{1.73 \times I \times Z \times L}{1000} = \frac{1.73 \times 35 \times .108 \times 250}{1000} = 1.6\ V_d$

Location_____ Sheet No. 45 of _____

By BWS Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject FAA NAT'L. STD.

DISTRIBUTION PNL "DPT1" ESSENTIAL POWER

CKT	DESCRIPTION		LOAD IN KVA
1.	PNL "RPT2"	TRANSF. #TT1&TT2	15
2.	PNL "RPT3"	#TT3 }	15
	PNL "RPT4"	#TT3 }	
3.	PNL "RPT 5"	#TT4 }	15
	PNL "RPT 6"	#TT4 }	
4.	FAN F-4 7½HP		9
5.	PNL "LPT1"		17.4
6.	LTG. MICROWAVE		1
		TOTAL LOAD	72.4

LOAD BASED ON FAA-ER-440-029 CRITERIA

FEEDER SIZE:

a) LOAD: $\frac{72.4\text{KVA}}{480 \times 1.73} = 87\text{A}$

b) WIRE SIZE: 87A x 1.25% = 109A
USE 4#3/0, 2½"C

c) FEEDER BKR. SIZE: 225A, 3P - (PARALLEL)

d) PANEL MAIN BKRS. 200A, 3P ; TIE BREAKER 150A, 3P

e) PANEL MAINS 225A

f) TRANSFORMERS #TT1, TT2, TT3, & TT4 SHALL BE 30KVA EA. WITH 50A, 3P BKR, 4#8, 1"C PRIMARY AND 4#2, 2"C SECONDARY.

g) VOLTAGE DROP CALCULATION: BASE ON THE SIMPLEX METHOD

FEEDER LENGTH: BASED ON 250'

LOAD: 87A

FORMULA: $V_d = \frac{I \cdot L \cdot Z}{1000}$

$Z = .0725$

$V_d = \frac{87 \times 250 \times .0725}{1000} = 1.6$ VOLT DROP OR .33% VOLT DROP

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By BWS Date_____ Job No._____

Chkd_____ Appd._____ Dwg. Ref._____

Client W. BECKET Subject FAA NAT'L. STD.

DISTRIBUTION PNL "11" DPT 2" ESSENTIAL POWER - CAB MECH. EQUIP

CKT.	DESCRIPTION	LOAD IN AMPS
1	AHU-1 7½ HP	11
2	C-1 20 HP NOTE 1	26
3	F-1 5 HP NOTE 1	7.5
4	DF-1 15 KW	18
5	ACCU-1 10 HP NOTE 1	14
6	ELEVATOR (34A F.L.)	34
7	AHU-2 3 HP	4.5
	TOTAL	115 AMPS

NOTE-1 NORMALLY OFF EQUIPMENT

FEEDER SIZE:

a) WIRE SIZE: DEMAND LOAD = 115A - 47A (NOTE-1) = 68A
USE 4#4/0, 3"C

b) FEEDER BKR: 300A, 3P

c) PANEL MAIN BKRS - 250A W/ 200A TIE BKR.

d) KVA = 115 x (1.73 x 480) = 96KVA

e) VOLTAGE DROP: BASE ON SIMPLEX METHOD

LOAD: 68A (DEMAND LOAD)
LENGTH: 250'

$Z = .0601$

$Vd = \frac{I \times L \times Z}{1000} = \frac{68 \times 250 \times .0601}{1000} = 1.02$ VOLT DROP

$\%Vd = \frac{1.02}{480} = .21\%$ Vd

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By BWS Date _____ Job No. _____

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Client W. BECKET Subject FAA NAT'L. STD.

TRANSFORMER STANDARD SERVICES:

30KVA 480V TO 120/208V, 3Φ, 4W TRANSFORMER

PRIMARY: 36A F.L.
WIRE SIZE: 36 x 125% = 45A
USE: 4#8, 1"C
FEEDER BKR: 36 x 150% = 54A
USE: 60A, 3P BKR.

SECONDARY: 83.4A F.L.
WIRE SIZE: 83.4 x 125% = 104A
USE 4*2, 2"C

ACCESS LEVEL LIGHTING

175W MERCURY VAPOR FIXTURE MTD. APPROXIMATLY 14' ABOVE GRATING. THE AVERAGE LIGHT LEVEL AT GRATING 6 FOOT CANDLES PLUS CONTRIBUTION FROM 3 ADDITIONAL FIXTURES AT 2 F.C. FOR A TOTAL OF 12 F.C..

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Location
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Chkd Appd

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Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

SANITARY : REF. NATL. PLUMBING CODE

1. FIXTURE UNITS:

a) TOWER

2 W.C.	@ 8 F.U	EA.	=	16 FU
0 LAV.	@ 4	"	=	0 "
2 LAV.	@ 1	"	=	2 "
1 DF	@ ½	"	=	½ "
1 FD	@ 1	"	=	1 "
			TOT =	20 FUs

TOT FUs = 20

2. BUILDING SEWER:

TABLE 115.2, NATL. PLUMBING CODE

4" SAN. @ 1/8"/FT. FALL = 180 FIXT. UNITS
USE 4' OUTSIDE BLDG.

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Job No.

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Client W. BECKET Subject NAT. STD. AIR TRAFFIC CONTROL TOWER

STORM REF NATL. PLUMBING CODE TABLES 13.6.1, 13.6.2.

1. ROOF AREA:

a) CAB.

5.5' X 18.5' X 11 = 1,119.25 SQ. FT.

2. VERT. LEADER FOR CAB SHALL BE 3" FOR 1,120 SQ. FT. OF ROOF AREA. (NATL. CODE ALLOWS 2200 ☐)

3. ROOF DRAIN SIZING

a) CAB: 1,119.25 ☐

CODE ALLOWS 822 ☐/3" RD OR TWO 3" ROOF DRAINS, BUT BECAUSE OF ROOF CONFIGURATION. THREE SHOULD BE USED

GAS

NO GAS SERVICE REQ'D.

WATER REF. NATL. PLBG. CODE TABLE D3.5
CAMERON HYDRAULIC DATA

1. FIX. UNITS
a) TOWER

2 WC	@ 10 FU	EA.	= 20	FU
1 SINK	@ 5	"	= 5	"
2 LAV	@ 2	"	= 4	"
2 DF	@ 1	"	= 2	"
		TOT.	31	FU_{CW}

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Subject NAT'L. STD. AIR TRAFFIC CONTROL TOWER

2. WATER SERVICE (COLD)

31 FU = 41 GPM
1½" PIPE WILL CARRY 41 GPM WITH A VEL. LESS THAN 10 FPS, BUT HEAD LOSS IS EXCESSIVE.

USE 2". TOWER CW. HEADER TO KEEP FRICT. LOSSES TO A MIN.

3. HOT WATER

a) CAB

LOAD = 2 LAV. USE 10 GAL. ELECT. WTR. HEATER

4. HIGH PRESSURE CW TOWER SERVICE
15 GPM – USE 1¼" FROM PRESSURE PUMPS.